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ELECTRONICS AND ELECTRICAL ENGINEERING

No. 92



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USSR REPORT  
ELECTRONICS AND ELECTRICAL ENGINEERING

No. 92

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UDC: 681.3.01:519.67

USING RECURRENT SPLINE FUNCTIONS TO PROCESS SPEECH AND VIDEO SIGNALS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 28 Mar 79) pp 60-64

SEREDINSKIY, A. V., VANDE-KIRKOV, V. A., BUZDALINA, I. A., OKUNEVA, I. K.,  
ORLOVA, M. I. and SOLONINA, A. I.

[Abstract] Spline functions meet the requirements of adequate recovery of encoded audio and video signals. The local conditions providing the possibility of stable construction of a spline are described. The algorithm for conversion of an initial signal using a spline approximation is presented, and represents a machine model of the process of selecting reference readings from a set of samples of the initial signal. An original image, a photograph of points selected as reference points (numbering 1/12 as many as the points on the initial image) and the restored image produced from these points are presented, as is a flow chart of the computer process used to generate the coded image. Figures 5; tables 1; references 10 Russian, 1 Western in translation.

[193-6508]



UDC 621.391.266

SYNTHESIS OF OPTIMUM SINGLE-CHANNEL SYSTEMS FOR SELECTION OF MOVING TARGETS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 12, Dec 81 (manuscript received 12 May 80, after revision 19 Nov 80)  
pp 73-75

KOSHEVOY, V. M. and MEDVEDIK, A. D.

[Abstract] On the basis of the Neumann-Pearson criterion, the present brief communication carries out a synthesis of a system for selection of moving targets in the class of linear discrete structures, as well as conducts an analysis of the effective solutions obtained. From the results of the analysis it follows that in practically all cases, i.e., with a change within wide limits of the amount of the processable pulses, the form of the spectrum of fluctuations and the width of its filters, synthesized with respect to the maximum of the average gain, loses in noise immunity to the filters synthesized with respect to the probability criterion derived in the present brief communication. Figure 1 of the text presents the dependences of the threshold signal on the number of processable pulses  $N$  in the case of synthesis with respect to the probability criterion and with respect to the maximum of the average gain. Figure 2 presents the amplitude-frequency characteristics of the filters, synthesized with respect to the probability criterion and with respect to the maximum of the average gain. In the second case the amplitude-frequency characteristic has a wider field of blind speeds and a large irregularity in the transmission field. Figures 2; references 3: 2 Russian, 1 Western.

[153-6415]

## ANALYSIS OF SENSITIVITY OF QUASI-OPTIMUM NONLINEAR FILTERING ALGORITHMS TO CHANGES IN INPUT EFFECT CHARACTERISTICS

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 4 Mar 81) pp 72-75

MIRONOV, M. A. and KORSKOV, A. N.

[Abstract] The theory of random Markov processes has been used in designing quasi-optimum devices for processing nonlinear signals. Because of a lack of experimental data it is usually not possible to give an accurate description of the statistical characteristics of filtered processes and noise and therefore at the final stage of solving the design problem it is necessary to make a quantitative estimate of the sensitivity of the quasi-optimum algorithms obtained to changes in input effect characteristics. This amounts to analyzing how much the quality of filtering worsens when these characteristics deviate from the calculated. Here an equation is obtained for the actual root-mean-square error in nonlinear filtering of Gaussian processes when input effect characteristics deviate from the calculated. This equation can be solved without employing the statistical modeling method. Equations are obtained within the framework of the method of Gaussian approximation, which is valid if it is assumed that worsening of the quality of filtering when the parameters of external effects deviate from the calculated must not exceed certain bounds which are determined by the size of the linear section of the discrimination characteristic. These bounds correspond to the maximum permissible values of filtering errors employed in practice. The calculation procedure described is illustrated by analyzing the sensitivity to deviations in input effect characteristics of a very simple device for optimum processing of signals in the rangefinder channel of the receiver of a radio very-short-range navigation system. It is shown that with the ranges of variation of these parameters encountered in practice it is possible to use relatively simple nonadaptive devices. The analysis procedure can be used for the general case of the filtering of diffusion processes and for analyzing the maximum permissible deviations in parameters of the receiving unit itself. Figures 2; references 9 Russian.  
[165-8831]

## REFLECTION OF PARTLY POLARIZED RADIO WAVES FROM RADAR TARGET

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 29 Oct 79, after revision 26 Dec 79)  
pp 47-52

KOZLOV, A. I.

[Abstract] The serious improvements which radar achieved in the problem of detection and distinguishability of radar targets placed on the agenda the problem of immediate determination of the measurements of particular parameters which characterize the target in question. This problem is of particularly great importance in the case of remote methods of determining the electrophysical properties of underlying surface features where the objects of investigation are various segments of the surfaces of the earth, ice and sea. The present work is concerned with the problem of determining the full power and degree of polarization of waves reflected from a radar target with irradiation of it by a partially polarized wave. On the basis of an analysis of the properties of a reflected wave, relations are found which make it possible to determine certain integral numerical characteristics of the same waves: 1) Full EPR of target, found during irradiation of target by a completely unpolarized wave; 2) Degree of anisotropy of target; 3) Some mean values of angles on a Poincare sphere [mean value of cosine of angle  $2\alpha$ ; and product  $(rb \sin 2\alpha)$ ]. Figures 2; references: 5 Russian.  
[91-A-6415]

## EFFICIENCY OF WEIGHTED CLUTTER SUPPRESSION IN NONCOHERENT RADAR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 8 Jul 80) pp 98-103

KISELEV, A. Z.

[Abstract] Detection of a moving target by a noncoherent radar involves weighted processing of signals

$$L(v, d) = \sum_{k=1}^n d_k v_k \text{ with suppression of clutter,}$$

where the weight vector  $d$  is defined by the equation  $Rd = \lambda R_1 d$  ( $\lambda$  is largest root of characteristic equation  $|R - \lambda R_1| = 0$  with  $R = R_{s1} - R_1$ ,  $R_{s1}$  and  $R_1$  are correlation matrices of observation vector  $v$  respectively in presence and in absence of useful signal). Here this problem is solved for the case of two pulses ( $n = 2$ ) in the packet processable according to an algorithm which consists of amplitude detection in the radar receiver, addition of weighting signal, distribution over distance channels, storage, squaring, and another storage. The structure of the weighting function is established for

the case of strong clutter and narrow-band interference. A numerical solution has been obtained on the basis of which the efficiency of the method can be evaluated. The efficiency is found to be particularly high in extracting Doppler data on range and velocity. It depends on the rate of signal fluctuation caused by flicker noise in the circuit, but does not depend on the signal level and depends on the noise level only in the case of a very narrow interference band. Figures 4; references 6: 5 Russian, 1 Western.  
[176-2415]

UDC 621.396.96:621.391.26

#### EVALUATION OF EXTENT OF OBJECTS IN SHORT-RANGE RADAR

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81  
(manuscript received 25 Nov 80) pp 32-35

SHELUKHIN, O. I.

[Abstract] In short-range radar, along with the problem of finding objects located at short distances from the radar, great interest is shown in the problem of measuring their overall dimensions, which is caused by insufficient information concerning the position of the "center of gravity" of an object in the case of detection of distributed objects in a strictly fixed area. The present brief communication considers aspects of an evaluation of the dimensions of objects by the noise of a short-range radar station with  $k$  space-diversity reception channels. The extended obstacle is characterized by a series of  $N$  "shining points", the number and position of which are random and at short distances it is necessary to take the curvature of the front of the incident and reflected waves into account. By determining the moment of scattering of the "shining points" which characterize the detected extended obstacle, it is possible to obtain an evaluation of its overall dimensions. References: 4 Russian.  
[163-6415]

UDC 621.396.967

#### DETERMINATION OF COORDINATES OF MOVING OBJECT BY AIRBORNE DETECTION AND RANGING SYSTEM

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 12 Mar 81) pp 55-59

[TRAN, THE VIET]

[Abstract] A discussion is presented of the principle of the design of a detection and ranging system located in a moving carrier making it possible at the same time to solve the problem of tracking a moving object and of

estimating its coordinates. In the approach generally used, whereby in the process of tracking the object an estimate is made of the parameters of the relative movement of the object and the carrier of the system and then the detection and ranging results are referenced to the coordinates of the carrier itself, the motion of the carrier of the system is one of the sources of error in tracking the object and estimating its coordinates. In order to reduce these errors it is possible to control the system's antenna by taking into account the predicted position of the object in space and making this prediction and estimating the coordinates of the object in a system of coordinates referenced to the surface of the earth. A theoretical analysis is made of this approach. Equations are presented for motion in discrete form, for discrete moments of time at which measurements are made and for the measurement vector in an orthogonal system of coordinates. Signals are represented in a form in which errors in measuring them are functions of primary errors, errors in determining the position of the carrier and the state of the system. Optimum estimates of the state vector, i.e., the position and speed of the object at each moment of time, and the optimum extrapolation of the state vector required for taking into account the motion of the object relative to the system's carrier when tracking the object are obtained by applying a generalized Kalman filter to the system of equations derived. The algorithm for this filter is presented and the results are given of a check of the effectiveness of this algorithm by means of simulation on a computer. It is demonstrated that the algorithm suggested for the operation of a detection and ranging system with a low space-sound'ng frequency provides a high degree of accuracy in determining coordinates and is characterized by transient processes of short duration. Figures 4; references 4: 2 Russian, 2 Western (1 in translation).  
[165-8831]

UDC 621.397.331.222 : 621.377.623.24

#### TELEVISION METHODS OF ESTIMATING OBJECT TRAVEL PARAMETERS

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 27 Apr 81) pp 51-53

BEZRUKOV, V. N., SAMOYLOV, F. V. and TSVETKOV, A. I.

[Abstract] The results are given of a study of variants of the method of determining the velocity and direction of travel of an object by estimating the parameters of the path of a special datum mark with a special shape and static distribution of brightness placed on the object. The path of the mark's travel is recorded on the target of a vidicon with a controlled memory (VRP), which displays the recorded information for 10 to 30 min. Complete information on the velocity of the object in the plane perpendicular to the optical axis of the camera is contained in the path recorded on the VRP target if the distance to the object, the true dimensions of the datum mark and the light flux coming from it are known. The parameters of the object's



travel can be analyzed just by determining the time required for the reading beam to cross the path of travel at a chosen point and by determining the amplitude of the video signal. By recording the path of the object's travel it is also possible to determine the instantaneous coordinates of the object. An experimental determination was made of the dependence of the value of the current of the vidicon's signal on the speed of the datum mark for various values of its light flux. It was demonstrated that the most suitable is a datum mark whose projection onto the target occupies 0.5 to 1 percent of the target's diameter; this makes it possible to determine the speed and direction of travel of an object with 10 to 100 lu of illumination of the target by the light flux from the datum mark. A visual estimation of the speed of an object can be facilitated by using a datum mark with some parameter which varies periodically, e.g., shape, size or light flux. The relative pulse duration and variation cycle must be so chosen that the line path of the mark obtained will be sufficiently distinguishable on the screen of a video monitor. When it is impossible to install a special datum mark on the object the above procedures can still be applied to the path of the object itself if the projection of the object onto the target is commensurate with the projection of a datum mark and the object or a part of it has a relatively simple configuration. To determine its speed reliably it is necessary to estimate the real light flux from the object at a given point; for this purpose an additional optical element is added to the camera to split the light flux which is directed to the vidicon target and to a photomultiplier tube. The signal from the latter's output acts as a signal correcting the value of the video signal produced in the camera's output. The image is projected through an optical system onto the vidicon target and the photomultiplier tube of a brightness estimating unit. Information on brightness is supplied from this unit to a memory to which is also supplied, from a zone selection unit, information on the number of the zone of the target onto which the datum mark is projected at the time in question. In determining the velocity vector information from the memory and zone selection unit enters the control input of an amplifier from whose output an amplitude-corrected video signal is produced which bears information on the velocity vector. Figures 4; references 2 Russian.

[165-8831]

UDC 522.24

DETERMINATION OF ANGULAR COORDINATES OF ASTRONOMICAL OBJECTS WITH USE OF OPTOELECTRONIC MEASURING SYSTEMS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 12, Dec 81 (manuscript received 8 Oct 79) pp 1-3

AVSENIN, B. N. and SELIVERSTOV, Yu. A.

[Abstract] An account is given of a method for determining the angular coordinates of astronomical objects, common for a number of stars  $K > 2$ , and calculating the coordinates of the objectives by the method of least squares. The results of processing a scene with a field  $1 \times 1^\circ$  and center coordinates  $A = 3^h48^m$  and  $D = 25^\circ33'$  are presented. The coordinates of the reference stars and the determinable heavenly bodies, as which catalog stars are taken, are presented in Table 1 of the work, and the results of calculation of the positions of the heavenly bodies and their errors in Table 2. The time for calculation of the proposed method on a BESM-4M computer amounted to approximately 0.1 second and by the Turner method to ~0.18 second. The problem of the comparative effectiveness of one or another method can become the subject of a special investigation. However, a priori it is possible to suggest that for optoelectronic systems the orthogonal method is more effective even if because the probability of appearance of two catalog stars in their field is higher than three. Tables 2; references: 8 Russian.  
[186-6415]

UDC 531.743

ANALYSIS AND EXPERIMENTAL INVESTIGATION OF ERRORS OF THREE-COORDINATE AUTOCOLLIMATOR

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81 (manuscript received 7 Jul 80) pp 40-42

KONYAKHIN, I. A. and PANKOV, E. D.

[Abstract] A 1980 report by the above authors describes the principles of operation, the metrological possibilities and the practical realization of a

three-coordinate autocollimator, which makes it possible to monitor the position of an object relative to three orthogonal axes, one of which coincides with the optical axis of the objective of the autocollimator (axis of torsion) and two others perpendicular to it (collimation axes). The present work gives an analysis and the results of an experimental investigation of the errors of measurement of a three-coordinate autocollimator. In addition, recommendations relative to an increase of its precision are given. In order to find the probability limit and values of the total error of measurement of angles, an analysis was made of the primary errors and relationships obtained for determining the partial errors with allowance made for the autocollimator parameters. The results of this are shown in a large table. Figures 1; tables 1; references: 6 Russian. [156-6415]

UDC 535.681.7

#### OPTICAL DEVICES FOR ADJUSTMENT OF ASTRONOMICAL TELEVISION EQUIPMENT

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81 (manuscript received 26 Jun 80) pp 18-20

VERZHBITSKAYA, G. M. and VIK, T. V.

[Abstract] The work describes the monitoring-adjustment devices KYuP-1 and KYuP-2 which assure monitoring and measurement of the parameters of astronomical television equipment [ATE] in accordance with a complex program, both up to the beginning of observations and in the process of their conducting. The complexity of evaluation of the parameters of ATE is achieved by the use of special interchangeable tests, with the aid of which a number of operations are performed. The technical characteristics of the devices are presented. The optical trains of the KYuP-1 and KYuP-2 are shown as well as an external view of them. Figures 4; tables 1; references: 2 Russian. [156-6415]

UDC 537.874.6:621.396.677:621.372.826

#### DIFFRACTION OF ELECTROMAGNETIC WAVES BY JOINT BETWEEN TWO-DimensionALLY PERIODIC WAVEGUIDE ARRAYS AND DIELECTRIC RODS

Gor'biy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 1, Jan 82 (manuscript received 28 Nov 80) pp 104-114

KREKHTUNOV, V. M. and TYULIN, V. A., Moscow Higher Technical School imeni N. E. Bauman

[Abstract] The problem of diffraction of electromagnetic waves by joints between nonorthogonal two-dimensionally periodic arrays of seminfinately



long circular waveguides and dielectric matching rods is solved by reducing the problem to a system of nonhomogeneous linear algebraic equations of the order  $4M + L$  ( $M$ - number of natural waves in a waveguide,  $L$ - number of natural waves in a transversely nonhomogeneous Flocke channel) for the coefficients of the scattering matrix. Results of numerical calculations by this algorithm are analyzed for accuracy, an error within 3% being typical for the reflection coefficient with respect to the fundamental wave, and found to be useful for wideband matching of antenna arrays with wide-angle beam scanning. Figures 4; references 7: all Russian. [194-2415]

UDC 550.388.2

# CURRENT INSTABILITIES AND STRATIFICATION IN BARIUM CLOUDS AT ALTITUDES OF E-REGION OF IONOSPHERE

Gor'kiy IZVESTIYA VYSSHYKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 24, No 12, Dec 81 (manuscript received 14 Apr 81) pp 1541-1542

GERSHMAN, B. N. and KRUPINA, A. Ye., Scientific Research Radio Physics Institute

[Abstract] Streaks with horizontal dimensions of 0.5 to 5 km extending along the geomagnetic field,  $H_0$ , have been observed within clouds in experiments in injecting barium into the ionosphere. These streaks have been observed both in the F-region and at altitudes of the E-region. Emphasis is placed here on the effectiveness of the current instability mechanism, for 2-stream and gradient instability, in the behavior of clouds in the E-region. An analogy exists with the excitation of small-scale inhomogeneities in an equatorial or auroral current stream, and in view of this analogy it is possible to make use of relationships already known in part for the frequency and rate of growth of perturbations, without requiring the extreme extensiveness of inhomogeneities along  $H_0$ . Inhomogeneities in electron concentration oriented along  $H_0$  originate in the presence of currents at altitudes of the E-region in the equatorial and auroral zones. For the origin of these inhomogeneities the currents must be strong enough for the velocity of electrons relative to ions to exceed or at least be commensurate with the isothermal velocity of ionic sound. The possibility exists of an effective role's being played by current instabilities because, on account of the greater ionic mass,  $M$ , for  $Ba^+$  ( $M = 137$  absolute units of mass), as compared with  $O_2^+$  and  $NO^+$  ions, the speed of ionic sound, proportional to  $M^{-1/2}$ , will be less inside the cloud than in the surrounding plasma. Plasma density gradients in clouds are more abrupt than in the unperturbed ionosphere. Current instabilities are analyzed on the basis of a system of quasi-hydrodynamic equations for electrons and ions, written for fulfillment of the quasi-neutrality condition. Equations are obtained for the frequency and rate of growth of perturbations similarly to how this was done for an equatorial current stream in earlier studies (1976, 1980).

Equations are written which use the symbols often employed in the theory of the instability of an equatorial current stream. These equations contain terms taking into account the possibility of the origin of current instability and of gradient instability and reflecting the damping effect of diffusion of the plasma. It is proven that both kinds of instability are caused by the presence of currents, within the framework of these equations. It is also proved that in barium clouds instability can originate only with  $\cos^2 \theta \ll 1$ , where  $\theta$  is the angle between the wave vector,  $k$ , and  $H_0$ . It is thus not necessary to be restricted to the ideal case of maximum extensiveness, where  $\cos^2 \theta = 0$ . With  $\cos^2 \theta \ll 1$  it is possible to state that for the streak structure usually recorded gradient instability must be more effective than current instability. Effective excitation is possible only with the great extensiveness of inhomogeneities along the direction of  $H_0$ . References 10: 3 Russian, 7 Western.  
[164-8831]

UDC 550.510.35

# INVESTIGATION OF DECIMETER RADIO WAVE PROPAGATION AT TRANSPOLAR TRACES DURING AURORAL SUBSTORMS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 24, No 11, Nov 81 (manuscript received 23 Jan 81) pp 1299-1305

BLAGOVESHCHENSKAYA, N. F. and BUBNOV, V. A.

[Abstract] The results are presented of a study of the special features of propagation of decimeter radio waves at several high-latitude traces with a length of 7-9 thousand km at the time of auroral substorms. Experimental observations were conducted in the winter period of 1976-1978 during night hours. It is shown that variation of the characteristics at transpolar traces during the time of auroral substorms depends on the time of commencement, the intensity and form of the coil of the H-components of the Earth's magnetic field, as well as the state of the ionosphere at the beginning of the perturbation. A distinct interdependence between changes of the levels of the shortwave signals and variations of the H-component of the magnetic field and the ionosphere parameters in the vicinity of the place of lead out of waves from the ionosphere wave channel [IWC] indicates the following. During waveguide propagation of decimeter waves on transpolar traces, from the daylight side to the night, the dynamics of the characteristics of shortwave signals is determined by the conditions of leadout of radio waves from the IWC. The experimental investigations conducted and their analysis makes it possible to conclude that there takes place a steady conformity in variations of the intensities of the shortwave signals on transpolar traces of large extent at the time of auroral substorms, which to a known degree make it possible to forecast the conditions of long-range propagation of decimeter waves in high latitudes in perturbed periods. Figures 5; references: 7 Russian.  
[150-6415]

## REFLECTION OF RADIO WAVES FROM METEOR TRAIL CONTAINING TWO KINDS OF IONS

Gor'kiy IZVESTIYA VYSSHKIH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 24, No 12, Dec 81

(manuscript received 17 Apr 80, after completion 12 Jun 81) pp 1459-1466

NOVIKOV, G. G. and TSYGANKOV, S. F., Institute of Astrophysics, Tajik SSR  
Academy of Sciences

[Abstract] A study is made of how the amplitude of a radio signal reflected from a meteor trail changes if the plasma contains ions of the same and differing polarity. In studying the problem of the reflection of radio waves from meteor trails the Gaussian distribution is usually employed, which is obtained on the assumption that the plasma of the trail consists of electrons and once-charged positive ions of the same kind; but by observation meteor trails have been encountered with an other-than-Gaussian distribution of electrons across the trail and ions of various substances have been observed in the plasma. It has furthermore been hypothesized that negative ions can also be contained in meteor trails. The presence of an additional kind of positive ions can result in the more complex distribution of electrons in the trail and in the fact that the diffusion coefficient will depend on time and tend toward a value consistent with the slowest ions, and the presence of negative ions can mean that the negative ions will be concentrated in the center of the trail because they are heavier than electrons and will force electrons out of this region. Two hypotheses are discussed: that the meteor plasma contains electrons and two kinds of positive ions, and that it contains electrons and positive and negative ions. The type of radial distribution of electrons is found for the first hypothesis, whereby it is assumed that the meteor plasma is thermalized and homogeneous along the path the meteor travels, so that the concentration of charged particles depends only on the distance from the axis of the trail and that it is possible to disregard the influence of the geomagnetic field on the diffusion of trails. The discussion is limited to trails of the incompletely consolidated type for which it is possible to disregard de-ionization processes. Equations are found for the concentration of ions of the first and second kinds. How the presence of a relatively small number of heavy ions influences the change in amplitude of a signal as a function of parameters of the ionic composition of the plasma. It is concluded that the presence of an additional kind of heavy ions slows a drop in amplitude of the reflected signal. The law for the change in amplitude of the signal is other than exponential and this difference increases both with an increase in the concentration of additional ions and with a reduction in their mobility. It is demonstrated that the dependence of the diffusion coefficient on time which has been observed can be a manifestation of the multicomponent composition of the plasma of the meteor trail. The radial distribution of electrons for the second hypothesis, i.e., taking negative ions into account, is found with the same assumptions used for the first hypothesis. It is concluded that the presence of negative ions results in

more rapid attenuation of the signal and can be a reason for the manifestation of fading. The presence of negative ions can also result in an increase in the effective diffusion coefficient during the existence of the reflected signal. The results obtained can serve as an indirect proof that negative ions exist in the meteor plasma. Figures 5; references 13: 8 Russian, 5 Western.  
[164-8831]

UDC 621.371

#### EFFECT OF TERRESTRIAL ATMOSPHERE ON PRECISION OF RADIO ENGINEERING MEASUREMENTS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81  
(manuscript received 11 Aug 80) pp 21-31

VINOGRADOV, A. G., KRAVTSOV, Yu. A. and FEYZULIN, Z. I.

[Abstract] Distortion of a signal during its passage through the terrestrial atmosphere is one of the essential factors which restrict the reliability and precision of contemporary radio engineering systems. It is necessary to take these distortions into consideration, both at the stage of planning new systems and in the process of operation of active systems. A circle of problems originating during an analysis of the distorting effect of the propagating medium on radar measurements is very wide and encompasses the theory of propagation of signals in nonhomogeneous fluctuating media and the statistical theory of detection and measurement of signal parameters. The present work proposes a consecutive and sufficiently general description of a method suitable for analysis of the precision characteristics of practically any coherent radio engineering system. An analysis of distortions of a signal in the medium is conducted on the basis of a multiscale model of the medium with a power-law spectrum of heterogeneities which describes sufficiently well the fluctuations of the refractive index in both the troposphere and the ionosphere. As an illustration of the method, matched filtering of the signal received is considered and an evaluation is given of the error of measurements caused by the effect of the medium. The following items are investigated: 1) Model of the distorted field of the medium; 2) Signal at the output of the receiving antenna; and 3) Simultaneous treatment of received signal. The authors deeply thank S. M. Pytov and D. S. Kontorov for attention to the work. Figures 1; references 10: 9 Russian, 1 Western.  
[163-6415]

## DETERMINATION OF WIDTH OF SPECTRUM OF RADIO ECHO OF MULTIPLE TARGET

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 7 Apr 81) pp 53-55

MEL'NIKOV, V. M.

[Abstract] Devices which record overshoots beyond a certain level of the output signal of a sounding system are widely used in remote sounding of a group of scatterers, in radar meteorology and in the acoustical sounding of meteorological objects, for example. When the sounding system emits continuously, by measuring the mean frequency of overshoots of the output signal it is possible to make a real-time determination of the root-mean-square frequency of the signal's spectrum, which is directly related to the root-mean-square velocity of the scatterers. A study is made here of the dependence of the mean frequency of overshoots of the output signal of pulsed coherent sounding systems on the characteristics of the signal spectrum. A calculation is made of the minimum time for recording overshoots in order to reduce the statistical uncertainty of measurements. The signal obtained after coherent detection is proportional to the quadrature component of the scattered field and this signal represents a Gaussian process with a zero mean, the mean frequency of whose overshoots beyond the mean level is determined by the root-mean-square frequency of the spectrum of this signal. An analysis is made of the accuracy with which it is possible to determine this root-mean-square frequency by the method of measuring the frequency of overshoots in pulsed radar systems. Curves are shown, illustrating the relationship between the mean frequencies of overshoots in the pulsed and continuous modes of emission as a function of the pulse repetition rate for three forms of the Doppler spectrum: Gaussian, uniform over the frequency band and triangular. An equation is derived for determining the minimum total measurement time and for the variance in the frequency of overshoots. The results demonstrate that, for example, the required measuring time equals 0.63 s for sounding meteorological objects with radiation 10 cm in wavelength with a pulse repetition rate of 1000 Hz with values of the root-mean-square velocity of scatterers of about 4 m/s, with uncertainty of less than 10 percent. The measurements described can be made in real time and can be implemented with simple equipment. Figures 2; references 7: 4 Russian, 3 Western.  
[165-8831]



## USSR-INDIA INTERNATIONAL TROPOSPHERIC COMMUNICATION LINE

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 11 Dec 81) pp 2-3

PLEKHANOV, V. V. and KHOLODILIN, G. M.

[Abstract] On 2 November 1981 a long distance tropospheric scatter communications line was opened between the USSR and India. This allows direct communications without requiring surface line transit through third nations. The basis of construction of the line was an international agreement between the USSR and India concluded in 1977 which called for the Soviet Union to develop and manufacture the hardware, while India produced the antennas. Two stations were constructed: one at Sanglok near the village of Dangara (Tadzhik SSR), the other at Charar-i-Sharif, near Srinagar. The stations both used type DTR-12 radio communications apparatus. Two space diversity antennas are used, connected to two receivers. Signal fading, fast and slow, occurs on the line. Two ten kW transmitters operate at different frequencies in order to provide frequency diversity reception, with a separation of 7.5 MHz. The end result of signal processing is the transmission of a 20 kW signal consisting of six equidistantly frequency-separated components 2.5 MHz apart with equal powers of 10/3 kW carrying identical information. The stations utilize existing ground equipment already present in both countries for transmission to Moscow and Delhi. References: 6 Russian.  
[193-6508]

UDC 621.396.967

## ANALYSIS OF EFFECTIVENESS OF POLARIZED REJECTION OF BEAM REFLECTED FROM EARTH'S SURFACE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 9, Sep 81 (manuscript received 10 Nov 80, after revision 8 Feb 81) pp 84-86

DIDENKO, Yu. I. and NIKITCHENKO, V. V.

[Abstract] Multipath propagation during radio communication with moving objects in the microwave band is one of the principal reasons for deterioration of the qualitative indices of communication. A number of methods have been developed for control of fading because of such propagation. The present brief communication investigates the simplest of the methods of adaption by polarization--the method of rejection of the reflected beam. The optimum polarization of the direct beam and the necessary power supply, with which it is necessary to have a radio circuit for compensation of the weakening of the direct beam because of nonorthogonality of the polarizations

of the direct and reflected beams are determined. Curves are presented, an analysis of which makes it possible to draw the following conclusions: Adaptive polarization of the reflection beam reflected from the earth's surface is a sufficiently effective method of control with fading in a wide band of strip angles  $\theta$ . The most suitable for use of the method in questions are angles in the range  $\sim 15^\circ \leq \theta \leq 45^\circ$  during which attenuation of the direct beam is absent. With small and large angles of slip, an abrupt decrease of the effectiveness of the method considered is observed. In order to assure at the receiving point the necessary level of signal with  $7.5^\circ \leq \theta < 15^\circ$  and  $45^\circ < \theta \leq 90^\circ$  it is sufficient to provide for an increase of the power of the radio circuit by 14 : 16 dB, which is considerably smaller than in the use of antennas of fixed polarization. Figures 3; references: 6 Russian. [91-A-6415]

UDC: 621.431 73.004.13

#### IMPROVEMENT OF OPERATION OF DIESEL GENERATORS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 24 Dec 80) pp 28-31

COLONAVOV, V. P., DARINSKIY, Yu. V., LARIN, V. Ye. and TISHCHENKO, M. P.

[Abstract] Diesel generators are widely used in such communications links as high latitude tropospheric scatter lines. Automation of their operation and particularly of lubrication can greatly improve the operating characteristics of the generators and the communication lines as a whole. This article discusses improved lubricant formulations and lubrication conditions, noting that simply increasing the level of additives to traditional motor oil for use in the far north is not sufficient, because many additives decompose during transportation and storage before use. An adaptive mathematical model of the process of operation of the K-657MM diesel is used in order to determine the optimal quantity and sequence of addition of additives to the lubricant as the engine operates. The annual savings to be achieved by the use of this operating system amount to 2,300 rubles per machine. Tables 2; references: 9 Russian. [193-6508]

UDC 621.396

#### DETERMINATION OF PROPERTIES OF GROUND BY MEASURING ANTENNA IMPEDANCE

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received after correction 10 Sep 81) pp 75-78

PAVEL'YEV, A. G. and BADER, V. A.

[Abstract] The fact that the capacitance of an antenna depends on the conductance of the soil and the height of the antenna above the ground

has made it possible to study the physical properties of the ground by measuring the antenna's impedance. In connection with space research applications, a study is made here of the possibility of solving the inverse problem, i.e., determining the structure of the ground from the measured dependence of the impedance on frequency or the height of the antenna's position above the ground. Hitherto it has been possible to obtain only approximate relationships relating the impedance of an antenna to the parameters of homogeneous ground and valid within a limited frequency range and range of ground parameters, and only for specific types of moist soil. There have been no expressions describing the impedance of an antenna located above a layered medium, and there is an integral relationship between the impedance of an antenna and the coefficient of the reflection of a plane wave from a layered medium. Here a study is made of the possibility of solving the inverse problem by impedance sounding of the ground. It is assumed that an antenna whose size is much smaller than the length of the radio wave radiated by it is at a height of  $h$  above the interface of the atmosphere and a layered medium. The type of antenna used is assumed to be arbitrary and the vertical dimension of the antenna is assumed to be much less than  $h$ . The antenna's impedance is represented as the sum of its intrinsic impedance in free space and an additional component which depends only on the parameters of the ground. A transform inversion equation is presented which represents the first stage of the solution of the inverse problem and at the second stage a priori information on the nature of the medium studied is enlisted. In order to obtain this information it is possible to use multilayered models and models with continuous variation in dielectric constant and conductance. Measurements are made of the dependence of the impedance on the height of the antenna above the ground with a fixed wavelength, and then a measurement is made of the impedance of the antenna in free space and the part of the impedance,  $Z_k(\alpha)$ , associated with the influence of the ground, where  $Z_k$  is the additional component of the impedance depending only on the parameters of the ground and  $\alpha = 4\pi h/\lambda$ , where  $\lambda$  is the wavelength of the radio waves emitted by the antenna. Experimental dependence  $Z_k(\alpha)$  is approximated by means of analytical functions of argument  $\alpha$  and an inverse Laplace transform is performed, mentioned above. Model representations are then employed to find the electrical parameters of the medium. It is demonstrated that in the sufficiently general case the inverse problem discussed can be solved by means of a Laplace transform, whereby the impedance of the antenna as a function of its height above the ground is the transform function and the coefficient of reflection of the plane wave from a layered medium as a function of the complex angle of incidence is the inverse transform function. The approximation by means of analytical functions of the dependence of the antenna's impedance on height is a necessary element in solving the inverse problem. The solution obtained can be used to process data from sounding the ground and the surface of planets. Figures 2; references 8: 6 Russian, 2 Western.

[165-8831]



## DESIGN OF EXCITER FOR REFLECTOR ANTENNAS WITH LARGE BEAM DEFLECTION

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received after completion 24 Jun 81) pp 79-81

CORLOV, M. G.

[Abstract] The design of an antenna with various distributions of the field in its aperture and degrees of deflection from the focal point for the purpose of producing the maximum directive gain in a given direction is discussed, and an analysis is made of phase errors and amplitude distributions in a reflector with various types of distribution of the field in the exciter's aperture. Calculation of the exciter was performed in two steps, considering the antenna in the reception and transmission modes, respectively. At the first step a determination was made of currents in the reflector with the incidence of a plane wave onto it at a specific angle. A Kirchhoff approximation was used at this stage and then a determination was made from these currents of the leakage field which would make it possible uniquely to determine the position and orientation of the exciter in space. The field in the exciter's aperture can be synthesized once the amplitude-phase distribution of the field in the focused spot is known. In the exciter's deflection plane the distribution of the amplitude of this field was written by using a trigonometric Fourier series and in the orthogonal plane by using a cosine function. Also considered were reflector antennas in which the phase distribution in the exciter's aperture was assumed to be cophased with the phase distribution in the region of the major lobe of the focused spot of the antenna. At the second step a determination was made of the dimensions of the exciter consistent with maximum directive gain in a specific direction. For this purpose the dimensions of the exciter were varied with various distributions of the field in the aperture. The exciter was placed at the point with the maximum concentration of energy and was oriented along the Poynting vector at this point. The directional patterns of an antenna with optimum dimensions of the exciter for each kind of distribution were calculated for the purpose of determining the width of the directional pattern and the level of side lobes. Phase errors and the amplitude distribution of the field in the reflector were calculated in two central orthogonal cross sections for exciters with various distributions of the field in the aperture. Calculations were performed for an antenna with a  $750\lambda \times 750\lambda$  square aperture and a focal length of  $750\lambda$  with vertical polarization. It is demonstrated that the edge of the reflector practically does not influence the formation of the major lobe of the directional pattern and consequently orientation of the exciter along the focal axis with great degrees of deflection from the focal point is justified. The calculation procedure makes it possible to obtain an increase in directive gain and to reduce the level of the first side lobe in the exciter's deflection plane. Under the conditions considered the directive gain increased 15 to 18 percent and the level of the first side lobe was reduced by 5 dB to equal -24 dB. Figures 3; references 3:

2 Russian, 1 Western.

[165-8831]

## MICROWAVE BREAKDOWN OF ANTENNAS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 25, No 1, Jan 82 (manuscript received 12 Dec 80) pp 93-98

ASTAYKIN, A. I. and SHCHANIKOV, N. I.

[Abstract] Microwave breakdown of antennas with cylindrical symmetry and radial field nonuniformity is considered, assuming that the field remains axially and azimuthally uniform. The breakdown characteristics are calculated on the basis of diffusion theory and the Townsend criterion. The breakdown buildup time becomes an important factor for antennas operating in the pulse mode, and here reaching the electron concentration  $n_{cr} = 10^{13}/\lambda$  in the plasma ( $\lambda$  - wavelength at the end of a pulse) serves as criterion. An experimental verification requires determination of the field distribution in the near zone, approximating the radial field profile with an  $E=E_{max}(\alpha/r)^k$  law ( $\alpha$  - antenna radius,  $k > 1$ ), and determining the coefficient  $M=E_{max}/P$  (input power for comparative and model evaluation. Actually  $E=E_{max}(0.93/r)^{0.98}$  and  $M=15 \text{ V}/(\text{cm} \cdot \text{W}^{1/2})$  were obtained in an experiment with a slot antenna and subsequent data processing by the method of least squares. The measured field-pressure characteristics agrees closely with calculations. Figures 4; references 5: 3 Russian, 2 Western (1 in translation). [194-2415]

UDC: 621.396.67:621.397.6

## USING MULTIPLE-ELEMENT ANTENNA ARRAYS TO RECEIVE AND RELAY TELEVISION SIGNALS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 4 Jun 80) pp 42-43

VAKHTIN, Yu. I., VOYTOVICH, N. I. and RASIN, A. M.

[Abstract] A simple signal addition scheme using 4- and 16-element arrays is suggested for transmission of television programs to fringe areas. The series-parallel connection of the 4 and 16 element arrays is illustrated. A 4-element array was used in order to increase the signal power at the input of a receiver device by a factor of 1.9; in combination with a solid-state amplifier with a noise coefficient of 3dB, satisfactory reception was achieved. Figures 2; references: 3 Russian. [193-6508]

## ADJUSTMENT DEVICE FOR PERISCOPIC ANTENNA SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 24 Dec 80) pp 46-48

KUHNE, ERICH, GDR.

[Abstract] A periscopic antenna system used in the FM-11,000 radio relay system developed in East Germany is described and a photograph of the antenna is presented. The method of adjustment of the antenna is based on the use of an additional transceiver with an omnidirectional antenna. After adjustment of the antenna the necessary position of the periscopic reflector in space can be determined. The adjustment procedure is briefly described. Since most radio relay intervals are within 1 to 1.5 degrees of horizontal, adjustment of supplementary antennas is not a serious difficulty. Practice has shown that the adjustment method here described greatly simplifies the adjustment of periscopic radio relay system antennas. Figures 4.  
[193-6508]

## DISTRIBUTION OF FIELD AT FOCUSING SPOT OF UMBRELLA-TYPE COLLAPSIBLE REFLECTORS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 9, Sep 81 (manuscript received 31 Oct 80) pp 60-61

LOMAN, V. I. and GRYANIK, M. V.

[Abstract] The flexible reflecting material of umbrella-type collapsible reflectors forms a surface differing from the surface of a paraboloid of revolution. This deviation of the reflector surface from the calculated leads to losses of the amplification factor, an increase of side lobes and an expansion of the principal lobe of the directional diagram. It is possible to increase the effectiveness of the umbrella-type paraboloids if one of the known methods of compensation for phase errors is used. However, for this purpose it is necessary to know the spatial pattern of distribution of the field intensity at the focusing spot as well as its dependence on the geometry of the reflector and the wavelength. In order to determine the characteristics of the focusing spot, the present brief communication considers the operation of the reflecting surface in a reception mode. It is shown that in the case of normal incidence of plane waves on the umbrella-type reflector, the spot with a maximum concentration of focused energy shifts from the geometrical focus to the side of the reflector at a distance which considerably exceeds the shift determined in a 1972 U.S. report from the literature. At the focusing spot, a redistribution of the field to its edges takes place. This points to the noneffectiveness of use in umbrella-type antennas of irradiating units with a point phase center. A twofold

change of the wavelength does not have an effect on the location of the focusing spot of the reflectors. Figures 2; references 6: 3 Russian, 3 Western.  
[91-A-6415]

UDC 621.396.677.8.001.5

#### EXPERIMENTAL RESULTS ON REJECTION OF INTERFERING SPACE SIGNALS IN RADIO OPTICAL ANTENNA ARRAYS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 24, No 11, Nov 81 (manuscript received 13 Feb 81) pp 1392-1397

GRINEV, A. Yu., KOMPANETS, I. N., TEMCHENKO, V. S., VASIL'YEV, A. A. and YEZHOV, V. A., Moscow Aviation Institute

[Abstract] A 1980 work of which A. A. Vasil'yev (see above) was the principal author, fully investigated a method of rejection of interfering signals in the input direction in plane antenna arrays, with coherent optical processing. In the present paper the results are given of an experimental verification of the 1980 work. A block diagram of the experimental system which implements an algorithm is shown and described. A depth of suppression on the order of 20 dB is achieved. The results of the experimental investigation demonstrate the effectiveness of the method considered. Figures 6; references: 5 Russian.  
[150-6415]

UDC 621.396.677.49

#### USE OF MULTIBEAM ANTENNA ARRAYS IN ADAPTIVE SYSTEMS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82 (manuscript received 23 Oct 80) pp 38-45

SAZONOV, D. M. and SHCHAPOV, Yu. M.

[Abstract] An adaptive antenna system is considered which includes a multi-beam array and a nondissipative radiation pattern synthesizer with complete decoupling and matching of inputs in a section. A circuit analysis based on the scattering matrix for plane incident waves, taking into account partial radiation patterns of elements as well as interaction of radiators, yields a relation for the signal-to-noise ratio at the output. A performance analysis of operation in the signal processing mode, with general relations applied to typical specific examples, reveals that this method of calculation yields estimates more accurate than asymptotic ones, especially as the distance between radiator elements decreases, and that with such an

adaptive system it is possible to reach the maximum attainable signal-to-noise ratio. Figures 3; references 17: 12 Russian, 5 Western. [176-2415]

UDC 621.396.677.494

#### PHASED ANTENNA ARRAYS WITH MINIMUM NUMBER OF MODULES

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received after completion 2 Jul 81) pp 31-38

POLUKHIN, G. A. and SHUBOV, A. G.

[Abstract] Phased antenna arrays with a minimum number of independently controlled antenna modules are considered promising for wide-aperture antenna systems, but special measures are necessary in order to prevent the level of the interference lobes of the radiation pattern of these arrays from rapidly increasing with an increase in the scanning angle and the directive gain from being lowered more rapidly than in relation to the cosine of the scanning angle with a corresponding sudden increase in the antenna's scattering coefficient. A practical compromise solution permitting a certain level of interference lobes in the scanning sector is the construction of phased antenna arrays with a minimum number of modules in which the modules have partly overlapping apertures with a relatively simple feeder system. A study is presented here of unidimensional equidistant phased antenna arrays of this sort consisting of independently controlled modules. The element analysis method is employed, without taking into account the influence of intercoupling between radiating elements and then an estimate is made of intercoupling effects. A determination is made of the maximum achievable beam, directive gain and scattering coefficient parameters in a limited scanning sector of 30 beam widths with a parallel circuit for feeding the elements of modules. Two types of arrays are studied: phased antenna arrays with the elements of modules distributed between the end elements of neighboring modules, and with the end elements of modules united in pairs. For scanning sectors covering a few dozen beam widths, either of these approaches results in lowering of the levels of interference lobes. With the first solution the effects of intercoupling when using a dipole above a screen as an element are insignificant with an even distribution of amplitude over the modules. When the amplitude drops module by module and when the length of these modules increases the influence of intercoupling tends to increase. Figures 7; references 8: 4 Russian, 4 Western (1 in translation). [165-8831]



UDC 621.385.832.56

PHOTOELECTRIC CHARACTERISTICS OF 'THICK' TARGETS OF KREMNIKONS

Moscow TEKHNIKA KINO I TELEVDENIYA in Russian No 10, Oct 81 pp 39-42

MATYNA, L. I., MOSHKIN, V. I., PEKAREV, A. I. and YAREMCHUK, A. F.,  
Institute of Electron Techniques, Moscow

[Abstract] The present report is concerned with an experimental and theoretical investigation of the possibility of intermediate control of the characteristics of a photodiode mosaic on "thick" targets up to the formation of membranes. Such investigations are also necessary in connection with a study of the possibility of creating kremnikons with a "thick" target which is characterized by an increased mechanical stability and increased photosensitivity in the short-wave region of the spectrum. The following items are illustrated: 1) Construction of targets with and without membranes; 2) Model of photodiodes; 3) Calculated and experimental spectral characteristics of "thick" targets; 4) Special characteristics of "thick" targets and targets with membranes, and those having photodiode mosaics identical with respect to topology; and 5) Spectral characteristics of "thick" targets measured for angles of incidence of light flux,  $Q_0 = 90^\circ$  and  $20^\circ$ . An analysis of the calculated and experimental data shows that measurement of the photoelectric characteristics of "thick" targets up to the production of the membrane can be used for the purpose of control of suitable devices in the production of targets with a membrane. The advisability of such control is caused by a significant correlation of the photoelectric characteristics of targets with and without membranes, operating under various conditions of illumination. In particular, scanning by an electron beam of photodiode mosaics of illuminated and nonilluminated "thick" targets reveals photodiodes with leakages and other defects. In addition, the introduction of control of the photoelectric characteristics of "thick" targets up to the production of membranes gives a definite economical effect because the cost of control operations does not exceed the cost of expenditures for the subsequent processing of defective targets. [Abstractor's note: A kremnikon is a new-type vidicon. The distinctive feature of the tube is high sensitivity to the effect of straight-line sun rays.] Figures 5; references 7: 4 Russian, 3 Western (2 in translation). [133-6415]

# DELAY IN INCREASE OF CHARGE PATTERN IN CAMERA TUBE TARGETS WITH INTERIOR PHOTOEFFECT

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 10, Oct 81 pp 37-39

PETRAKOV, A. V. and POPOV, Yu. G., All-Union Correspondence Electrical Engineering Institute of Communication

[Abstract] A theoretical evaluation is made of the build-up time of the charge pattern in the targets of kremnikons and plumbikons, which coincides sufficiently well with the experimental values of these magnitudes. An evaluation is also made of a vidicon with a stibnite layer. [Abstractor's Note: A kremnikon is a new-type vidicon, not described in this paper. The distinctive feature of the tube is high sensitivity to the effect of straight-line sun rays. A plumbikon is another new-type transmitting tube of the vidicon type, the photoconducting layer of which consists of lead oxide, which, together with good sensitivity assures independence from illumination and negligible inertia. The signal-to-noise ratio in a plumbikon is substantially higher than in the orthicon. The plumbikon is used in both black and white and color television.] Figures 3; references 12: 10 Russian, 2 Western.  
[133-6415]

UDC 621.385.832.564.4:621.397.132

# LI472 TWO-SIGNAL VIDICON FOR MINIATURE COLOR TV CAMERAS

Moscow TEKHNKA KINO I TELEVIDENIYA in Russian No 1, Jan 82 pp 47-50

VISHNEVSKIY, G. I., GERSHBERG, A. Ye., KORSHUNOVA, G. I., KUZ'MINOVA, Z. I. and MARKIZOV, A. S.

[Abstract] A description is given of the LI472 2-signal vidicon developed in the USSR for generating red and blue color signals for use in a 2-tube camera. It is used in conjunction with an LI465-1 vidicon which generates a wideband green signal, and both have identical electro-optical systems and differ only in the design of the input window. The LI472 is 106 mm long and 13.5 mm in diameter and weighs about 20 kg. All electrodes are connected via a voltage divider, making possible exceptionally stable operation of the camera in which this vidicon is used. In the input window a fiber optics disk is used on whose inside surface are applied the pickup late and photoconductive film, and to whose outside surface is cemented a monolithic glass disk with a light-coding filter applied to its surface. Bands on this filter are perpendicular to the horizontal scanning direction and the filter admits the blue light component and does not admit the red component. As a result of this, the portion of the charge pattern created by the red light component is of a periodic nature. There is no red component beneath

the filter's bands and no pattern is created by it, but this component takes part in creation of the pattern in the space between bands. The red signal is produced by separation by means of an electrical filter of the variable component created in the signal current in switching of this pattern by means of the electron beam. A low-frequency filter with a 0.5-MHz passband separates the blue signal and the direct-current component of the red signal. The light-coding filter is fabricated by using interference coatings which consist of materials having various refractive indexes, i.e., high-melting oxides which are insensitive to the influence of humidity and have optical properties which are stable over time. The signal modulation factor at the subcarrier frequency almost does not depend on the illumination intensity. The photodiode target used is based on cadmium selenide. The basic elements of the electro-optical system are a single electrostatic lens formed by three cylinders and two pairs of flat deflection plates. Figures 5; references: 1 Russian.  
[168-8831]

UDC 621.397.611

#### ELECTRONIC EDITING OF VIDEO SOUND TRACKS

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 1, Jan 82 pp 37-47

SHAPIRO, A. S., All-Union Scientific Research Institute of Television and Radio Broadcasting

[Abstract] A survey is presented of the state of the art of electronic editing of video sound tracks. In electronic editing "splicing" is performed automatically by means of an editing video tape recorder while the program is being played back for recording. The makeup method of electronic editing is the most widespread; a program is put together from fragments of finished programs or from recordings of individual scenes. With modern technology this type of electronic editing of a video recording takes approximately as long as the similar editing of motion picture film materials. The electronic editing production process includes the basic operations of 1) reviewing original video sound tracks and drawing up an editing plan, 2) marking original sound tracks with the repetition and correction of individual fragments and splicing between these fragments and 3) electronic editing of the program to be broadcast. The improvement of electronic editing systems is mainly directed at shortening the length of the last two operations. A major advance in the marking and coding of video sound tracks is the address time code, which makes it possible to actually mark every frame of a TV picture and thus to accomplish precise frame-by-frame editing of a TV program. A code word consists of 80 bits and has a length of 40 ms, corresponding to a single picture frame. The use of the address time code has made off-line editing possible, whereby all preliminary operations are performed on working copies of the original material. In the preliminary operations period an editing program is written which is entered into the memory of a computer which automatically controls video



tape recorders. Four-head video tape recorder electronic editing systems are discussed, including systems made by Ampex, Bosch Fernseh, CBS, Memorex and RCA. Video tape recorders which employ the oblique line method of recording and which are furnished with a time distortion corrector and autotracking represent a great advance in electronic editing technology. Modern studio 25-mm video tape recorders are not inferior in image quality to the standard established for 50-mm 4-head units and have good sound characteristics. The guaranteed service life of video heads is greater than 1000 h and a 1-hour program occupies about 40 percent of the space of a 1-hour program on 50-mm tape and costs two times less. The oblique line recording method has made possible the development of a new trend in TV broadcasting--video journalism. Here electronic editing is the key operation in program production. Presently three major oblique line recording formats are used: B, C and U; there is not compatibility between complexes based on these formats. A survey is given of complexes of video recording and electronic editing equipment produced in various countries, with individual attention devoted to equipment made by Bosch Fernseh (FRG), Ampex (USA), Thomson-CSF (France), Sony (Japan) and RCA (USA). Modern development trends are surveyed. It is hoped that in the future only magnetic tape will be used at all stages of TV program production. In motion picture film production a magnetic recording of the picture and sound on a single tape will be made concomitantly with the process of filming with 35-mm negative motion picture film and the recording of sound on 6.25-mm tape. Then all working editing operations can be accomplished electronically. Figures 4; references 16: 9 Russian, 7 Western (6 in translation). [168-8831]

UDC 621.397.61:65.011.56:681.325.5-181.4

#### USE OF MICROPROCESSORS FOR AUTOMATION OF TELEVISION SYSTEMS

Moscow TEKNIKA KINO I TELEVIDENIYA in Russian No 10, Oct 81 pp 34-37

TIMOFEYEV, B. S., Leningrad Institute of Aviation Instrument Building

[Abstract] The present work is concerned with the problem of further improvement of the qualitative and operational characteristics of television systems, and in particular the problem of long-duration stabilization of the qualitative indices of television cameras and camera channels, insurance of accuracy and automation of adjustment before the start of transmission and in the process of technical maintenance, and reduction of the expenditure of time on adjustments. The solution of this problem can be accomplished in two ways: 1) Conservation, i.e., development of individual units of the system; and 2) Active control with the aid of specialized computers or microprocessors of many parameters of a regime for attainment at each moment of time of the best value of the quality index vector. A large number of indices, algorithms of operation of transducers and methods of optimization are discussed in the work. Figures 3; references 5:

4 Russian, 1 Western.

[133-6415]

## 'RITM-320' TAPE RECORDER

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 1, Jan 82 pp 25-31

ALEKSEYEVA, S. F., GEL'PERN, G. A., GERTSEVA, I. A., GUDASOV, V. V. and KARPOV, I. V., "Ekran" [Screen] Scientific Production Association Central Design Bureau for Motion Picture Equipment

[Abstract] A description is given of the "Ritm-320" 2-channel portable tape recorder designed for primary synchronous sound recording in motion picture making. This unit basically represents a modification of the "Ritm-310" with the tape transport and drive system borrowed from it but with the utilization of silicon transistors and a new series of microcircuits. Modifications were aimed at improving reliability and at modernization of equipment being produced. The "Ritm-320" will make it possible to record sound effects and dialogue for stereophonic sound films, both photographic and videotape, will make possible the recording of music outside the study for monophonic films with sound balancing performed at film studios and will make it possible to record documentaries with the possibility of segregating either channel depending on final requirements. The tape recorder features a third auxiliary channel for recording a code, enabling the use of coded information for automated editing. The "Ritm-320" is the basic unit of the KZMP-9 portable recording complex. It can operate in synchronism with any synchronous or synchronized motion picture camera. It uses 6.25-mm unperforated magnetic tape of the TU6-17.610-74 A4407 and A4409 type. Its nominal tape speed is  $190.5 \pm 0.5$  percent mm/s, flutter and wow are 0.07 percent, it accepts reels with a maximum diameter of 180 mm, it has a nominal output level of +6 dB with a maximum permissible output signal level of +16 dB, a minimum microphone input signal level of -78 and a maximum permissible of -10 dB, a frequency response of 31.5 to 16,000 Hz for recording and playback and record-playback channel harmonic distortion of 1.5 percent with A4407 tape. It weighs 6 kg and can be powered from a 127/220 VAC line, a -10 V electronic power supply or a 12 to 18 V independent supply. The two channels are recorded on symmetrically positioned tracks 2.2 mm wide with a 0.4-mm-wide auxiliary data track between them for recording a synchronizing signal or code. Monitoring of the recorded signal by means of headphones or built-in or external loudspeakers is possible. Four independent sources can be connected to the tape recorder, including two microphones and two monophonic mixer consoles. The 2-stage microphone amplifier utilizes a type KT3107Ye transistor in a common-emitter circuit for the input stage and a K140UD7 integrated microcircuit connected in non-inverted fashion as the output stage. The "Ritm-320" has successfully passed tests at the Moscow Motion Picture Studio and is being series produced as of 1982. Figures 5; references: 2 Russian. [168-8831]

## MOTION PICTURE FILM PRODUCTION OPPORTUNITIES FOR USING VIDEO UNIT

Moscow TEKHNICA KINO I TELEVIDENIYA in Russian No 1, Jan 82 pp 56-58

PRYADKO, A. M. and KHALYAPIN, V. V., Kiev Motion Picture Studio for Art Films imeni A. P. Dovzhenko

[Abstract] A discussion is presented of possible variants of utilizing the "Soyuz" motion picture and television filming complex which was developed and introduced more than 8 years ago at the motion picture studio imeni A. P. Dovzhenko. Quality indicators are given for one optimum variant. The single-channel variant consists of a video unit, a television channel unit, a remote control and monitoring unit, a video tape recorder, video monitors and a microphone. The video tape recorder together with the remote control and monitoring unit comprise the video engineer's console. Also included is an autotransformer through which the drive of a motion picture camera, which is physically combined with the video camera, is powered. The complex can operate in the filming, repeat and review modes. A clean sound recording is produced because of the relatively low noise level of 26 dB. Also described is the on-location "Izofon-2" complex, whose main equipment is housed in a van. The "Izofon-2" complex records sound on 6.25-mm tape and uses three microphones and two radio microphones and also makes possible synchronous sound reproduction when filming with a sound track. The unit features an editing console and a remote monitor with a director's console. The "Soyuz" motion picture camera has been modernized by reducing its weight and size. A director's console has been developed which makes it possible to film on two channels at motion picture studios. The motion picture cameras can be connected independently of one another so that filming can be performed by turns with 3-second overlaps. The production capabilities of the 2-camera "Soyuz" complex are discussed in detail for the repeat and filming modes. The complex is highly reliable with a mean time between failures of not less than 800 to 1000 hours. Figures 5; references: 5 Russian.

[168-8831]

UDC 621.372

PLANNING OF POLYNOMIAL MICROWAVE FILTERS, ALLOWING FOR Q-FACTOR OF  
RESONATORS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 14 Jul 80, after revision 12 Dec 80)  
pp 62-64

CHIKUNOV, L. I.

[Abstract] The present brief communication proposes a tabular method of planning polynomial microwave filters which does not superimpose limitation on the value of  $\omega Q$  (where  $\omega$  is the bandwidth). The geometrical dimensions of the filter investigated are presented in Table 1 of the communication. It is shown that the formulas proposed and the tables presented make it possible fairly simply to compose a program for machine planning of an opposing column filter without limitations on the parameter  $\omega Q$ . Figures 2; tables 2; references 3: 2 Russian, 1 Western in translation.  
[91-A-6415]

UDC 621.372.54.037.372

EXPERIMENTAL INVESTIGATION OF CHARACTERISTICS OF ANALOG-DIGITAL ADAPTIVE  
FILTER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 22 Aug 80) pp 2133-2140

KOROL'EV, I. A. and MAL'TSEV, A. A.

[Abstract] This work presents the results of measurements of the characteristics of an analog-digital adaptive transversal filter (with analogous input and output signals), and the experimental results and theoretical calculations are compared. An adaptive transversal filter based on a delay line is considered and a block diagram of the unit is presented and explained. A description is given of an experimental analog-digital adaptive

filer. The circuit of an analog-digital delay line with branches is shown. A block diagram is presented of an experimental apparatus for investigation of the characteristics of an adaptive filter. Experiments concerned with an investigation of the characteristics of an adaptive filter were conducted on the apparatus with the use of it for modelling of time delay and a low-frequency filter of the first order. Figures 8; references: 6 Russian. [138-6415]

UDC 621.372.852

#### ITERATIVE BAND-PASS FILTERS BASED ON 'BEYOND LIMITS' WAVEGUIDE-DIELECTRIC STRUCTURES

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81  
(manuscript received 20 Dec 80) pp 9-14

KAPILEVICH, B. Yu., BERGER, M. N., ISHCHUK, A. A. and BEZUGLOVA, O. N.

[Abstract] Two methods are proposed for calculation of small-sized iterative microwave filters using "beyond limits" waveguide-dielectric structures based on the tabulated parameters of the elements of prototypes: low-frequency filters of the ladder type and stepped transition. For both variations a calculation is made of the parameters of the resonance sections and distribution of the loaded Q-factors. Using concrete examples, the practical realization is considered of iterative filters, and an evaluation is made of the quality of the filters with the aid of the criterion "index of dimensions". It is concluded that as a whole, use of prototypes makes it possible to achieve satisfactory conformity of calculated and experimental data, particularly if it is taken into account that the resulting amplitude-frequency characteristic of the filter is formed as the result of interaction of a large number of factors which in real conditions are reproduced with scattering. A comparison of the LC- and a stepped prototype shows that filters designed on the basis of a LC-prototypes ( $N = 5$  and more) are very critical to production tolerances, and with a disturbance of the symmetry of their resonance sections they are not always possible to adjust. In filters calculated with the aid of a stepped prototype with five and more sections, it is found that the number of nulls of the reflection coefficient is two less than the number of sections, but with a larger number of sections this is unimportant. The index of overall dimensions of filters of a given class amounts to  $G = 0.5-1.0$  in the 8-10 GHz frequency range, which indicates the outlook for their use in microwave equipment with rigorous requirements on weight and size indices. Figures 4; tables 2; references 9: 7 Russian, 2 Western. [163-6415]



## THERMALLY STABLE STRIP FILTERS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 21 Dec 80) pp 44-46

BFLEVICH, N. S., MUSSEL', K. M. and RABINOVICH, A. G.

[Abstract] Microwave strip filters which have good thermal stability and low cost are required. Crossed-rod microwave strip filters with thermal stabilization of AFC with cost factors similar to nonstabilized filters are described. Semiresonator crossed-rod strip filters with central frequency 1753 MHz and maximum reflection factor 0.01 in the 33 MHz band were tested. The filter body measured 40 by 20 mm. The filter was tested in the -50 to + 85°C range with a panoramic meter and digital frequency meter, showing that changes in temperature did not alter the filter characteristics. Figures 3; tables 1; references 4: 2 Russian, 2 Western.  
[193-6508]

UDC 621.378.325

## INTERFERENCE-POLARIZED FILTER IN LIQUID LASER BASED ON DYE WITH LAMP PUMPING

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81  
(manuscript received 10 Jun 80) pp 58-59

ARISTOV, A. V., IOFFE, S. B., KOZLOVSKIY, D. A., KUZNETSOV, B. V. and MASLYUKOV, Yu. S.

[Abstract] The results are presented in this brief communication of an investigation of the potentialities of a concentration of the energy of radiation generation of liquid lasers based on dye with pulse lamp pumping, in fairly narrow spectral lines without significant energy losses. For the experimental investigation, a 5-strip interference-polarized filter was prepared from a plate of crystalline quartz and Iceland spar inclined at a Brewster angle to the axis of the laser resonator in order to minimize the optical losses. The communication shows the high-energy effectiveness of using the filter for introduction of narrow generation lines and retuning it in the limits of the luminescence band of the dye. With narrowing of the spectral generation lines by more than three orders, the energy of generation is decreased by less than two times. Figures 2; references 7: 2 Russian, 5 Western.  
[156-6415]



## STABILITY OF AUTOMATIC FREQUENCY CONTROL SYSTEM WITH SECOND-ORDER FILTER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 20 May 80) pp 113-116

PONOMARENKO, V. P.

[Abstract] Dynamic characteristics and stability of an automatic frequency control system with second-order low-pass filter, describable by the transfer function  $F(p) = (1 + \tau_0 p)(1 + \tau_1 p + \tau_2 p^2)^{-1/2}$ , are analyzed on the basis of the corresponding nonlinear system of equations

$$\frac{dx}{dt} = y, \quad \frac{dy}{dt} = \beta - \phi(x) -$$

$-\ [\lambda + b\phi'(x)]y$ ;  $\tau = t/\tau_2^{1/2}$  is dimensionless time,  $x$  is instantaneous frequency deviation,  $\beta$  is initial frequency mismatch,  $\lambda = (\tau_1 - \tau_0)/\tau_2^{1/2}$ ,  $b = \tau_0/\tau_2^{1/2}$ ,  $\phi(x) = x + D(x)$  and  $D(x) = 2\alpha x/(1 + \alpha^2 x^2)$ . The phase portraits of this system reveal stability in the region of high gain. The stability region here, unlike for a system with first-order low-pass filter, is determined not only by initial frequency mismatch  $\beta$  and nonlinearity  $\alpha$  of the frequency discriminator but also by parameters  $\lambda$  and  $b$  characterizing the system inertia. Figures 2; references: 6 Russian.  
[176-2415]

UDC 681.513.6

## STATISTICAL CHARACTERISTICS OF ADAPTIVE FILTER ERROR SIGNAL

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 1, Jan 82 (manuscript received 12 Nov 80) pp 71-78

MALAKHOV, A. N., MAL'TSEV, A. A. and POZUMENTOV, I. Ye., Gor'kiy State University

[Abstract] An adaptive filter consisting of a transversal one with feedback and with controllable weight factors at the taps is considered for identification of an unknown system, i.e., for identifying the 2N-dimensional vector of its parameters. The adaptive identification process involves search for the minimum mean-square error according to the continuous steepest-descent algorithm based on a differential equation which describes the behavior of the weight factors vector. The power of the error signal  $\langle \epsilon^2 \rangle$ , a principal indicator of identification accuracy, is calculated from the system of differential equations for the moments of the  $\{\epsilon(t), \epsilon(t)\}$  set, assuming that the random amplitude  $a(t)$  of the input action  $x(t)$  is a Gaussian Markov process. The statistical characteristics of the filter error signal are determined on this basis for the important particular case of an amplitude-modulation input signal with telegraphic envelope statistics. General expressions are derived for the correlation function and the power spectrum of the filter error signal. Figures 3; references 8: 7 Russian, 1 Western.  
[194-2415]

UDC 550.388.2

CALCULATION OF MAXIMUM APPLICABLE FREQUENCIES OF SHORTWAVE  
COMMUNICATION LINES ALLOWING FOR EARTH'S MAGNETIC FIELD

Moscow RADIOTEKHNICA in Russian Vol 36, No 12, Dec 81  
(manuscript received after completion 24 Apr 81) pp 35-37

BARABASHOV, B. G. and VERTOGRADOV, G. G.

[Abstract] In spite of the growth of machine methods for rigorous calculation of the maximum applicable frequency [MAF] of shortwave communication lines which are based on determination of the radial trajectories in the magnetoactive ionosphere, it is a fairly time-consuming process connected with considerable expenditures of machine time. In the present brief communication a method of readjustment is calculated which makes it possible with high precision to determine by the method of transmission curves the MAF of shortwave radio lines, allowing for the Earth's magnetic field. The readjustments calculated by the method described are compared with known data with respect to oblique sounding. The good agreement of the results of a calculation with experimental data points to the advantages of the method described for determining readjustments and makes it possible to assume it is fully suitable for engineering calculations of MAF and the interval  $f \in \text{MAF}_x \rightarrow \text{MAF}_0$ . The latter characteristic is particularly important for a trace of short length because the frequency region under consideration can prove to be unique for all the frequency characteristic of a trace where multiple beamness is minimal. Figures 1; tables 2; references 6: 4 Russian, 2 Western.  
[163-6415]

## STABILITY OF ELECTRIC POWER SUPPLY SYSTEM FOR COMMUNICATION APPARATUS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 15 Oct 80) pp 31-35

PROSTOTIN, V. V.

[Abstract] When the load is connected to a primary power supply through a pulse-width modulator, self-oscillation of the output power supply voltage may occur, with the voltage reaching double the nominal value, significantly decreasing the reliability of the apparatus and possibly even causing failure. This work studies the causes of development of oscillation in power supply circuits and methods for its elimination. The stability of a rectifier can be increased by adding additional loads such as a ballast resistor parallel to the rectifier filter choke. This increases power supply stability but also increases output voltage pulsation coefficient. A buffer power supply is suggested which is absolutely stable, but under emergency conditions when the storage battery is disconnected for some reason the stability may be lost. Figures 6; references: 6 Russian.  
[193-6508]

## DYNAMICS OF TRANSIENT PROCESSES WITH PULSE-TONE SYNCHRONIZATION OF FREQUENCY MULTISTABLE SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 12, Dec 81 (manuscript received 25 Feb 80) pp 48-53

ABGARYAN, V. V. and MINAKOVA, I. I.

[Abstract] The wide class of frequency multistable systems includes self-oscillating systems [SOS] with delay feedback [DFB] and regeneration simultaneously in several feedback channels. A combination in multiple-loop systems of DFB and nondelaying feedback [NDF] channels which contain linear or nonlinear oscillatory circuits significantly expands the possibility of control of the states of the system. Introduction of a regeneration channel which contains a resonant circuit leads to the presence in the system of a regime for control of it by the properties of two different processes with substantially different time and spectral characteristics. In so doing, the greatest interest for practical applications is evidently presented by the case where the characteristic time of response of the system for the exterior or parametric manipulated variables with respect to the NDF channel,  $t^*$ , has a much smaller time lag with respect to the channel of DFB,  $\tau$ . The present work considers one of the variations of the class of SOS with DFB. The system comprises a nonlinear amplifier and a broad-band

nondispersion delay line in a closed state ring. A supplementary regeneration channel of NDF with the inclusion of a resonating element (in the general case - nonlinear) enters into the system. The class of SOS considered assumes a very suitable (with the aid of an oscillatory circuit--linear or nonlinear) band rearrangement of the spectrum of equidistant natural frequencies of an autonomous system concentrated around the resonance frequency of a circuit, and a variation of the ratio of the transmission coefficient with respect to both feedback channels makes it possible sufficiently simply to change the number of different stable states of the system also including single frequency. The calculated theoretical characteristics of the transient process with pulse-ton synchronization were checked experimentally with the aid of a low-frequency electroacoustical model of the SOS with DFB under consideration, in an autonomous regime. The principal circuit of the variant is presented. An acoustic delay line was used with  $\tau = 0.01$  as well as with sufficiently uniform amplitude-frequency characteristics in the field of audio frequencies arranged around the resonance frequency of the oscillatory circuit ( $f_0 = \omega_0/2\pi \approx 15$  kHz). The results of the experiment qualitatively confirm the theoretical calculations. Figures 3; references: 4 Russian. [153-6415]

UDC 621.376.9

#### SUBOPTIMUM NONCOHERENT DEMODULATORS OF SIGNALS LIMITED IN SPECTRUM

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received after completion 25 Aug 81) pp 19-27

MAKAROV, S. B., MEDVEDEV, B. M. and TSIKIN, I. A.

[Abstract] Intersymbol interference is caused by limitation of the spectrum of emitted signals. In order to avoid the necessity of analyzing a great number of different types of signals corresponding to sequences of transmitted symbols it is recommended that simpler suboptimum methods of reception be studied. The results are given here of theoretical and experimental studies of the noise immunity of suboptimum algorithms for the noncoherent element-by-element reception of signals limited in spectrum under conditions of frequency-shift keying. A suboptimum signal processing algorithm which employs averaging with respect to the possible forms of signals received is presented and analyzed, as well as suboptimum algorithms which utilize information on previously received symbols in demodulation of the signal. The effectiveness of the suboptimum algorithms discussed is evaluated by comparing their noise immunity with that of methods of noncoherent reception not designed for processing signals under conditions of intersymbol interference. The signal processing algorithm which averages for the possible forms of signals received can be implemented with discrete-analog matched filters which can be used to create rather simple miniature demodulators. Type 528BR1 integrated microcircuits, representing charge-coupled devices, can be used as discrete-analog delay lines. Experimental

studies were made of the noise immunity of the algorithm mentioned when implementing signal demodulators based on discrete-analog matched filters. It was demonstrated that the use of suboptimum noncoherent signal processing algorithms for signals limited in spectrum makes it possible to increase substantially the noise immunity of reception as compared with demodulating signals by means of a receiver which does not take into account intersymbol interference. The instrument losses of the discrete-analog demodulators discussed under the signal reception conditions considered are not greater than 1 to 2 dB over the range of the probability of erroneous reception of frequency-shift-modulated signals of  $10^{-2}$  to  $10^{-3}$ . Figures 6; references: 11 Russian. [165-8831]

UDC 621.383.6

#### DEVELOPMENT OF WORK ON RADIO OPTICS IN POLAND

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 25 Jan 81) pp 11-18

SZUSTAKOWSKI, M.

[Abstract] A survey is presented of research in the Polish People's Republic on the acoustooptical processing of radio signals. [This paper was reported at the 1st All-Union Conference on Radio Engineering held at Frunze in 1981.] Spectrum analyzers and correlators are used for the acoustooptical processing of radio signals and the basic element of this equipment is the acoustooptical light modulator, which transforms an electromagnetic radio signal into an acoustical signal which modulates a laser beam. The diffracted beam is deflected in the direction of propagation of the acoustic wave and by measuring the amount of this deflection, which is proportional to the frequency of the radio signal, it is possible to determine the spectrum of the signal in real time. Studies are under way in the development of acoustooptical modulators, on optical image conversion and on optical heterodyning. As transducers for acoustooptical modulators thin-film CdS and ZnO devices operating at frequencies of 1 to 3 GHz have been used, as well as single-crystal wafers of  $\text{LiIO}_3$  and  $\text{LiNbO}_3$  for frequencies of 30 to 500 MHz. Crystals of  $\text{TeO}_2$  and  $\text{PbMoO}_4$  are being grown in a number of laboratories in Poland for use as acoustooptical materials. Diagrams are presented of apparatus for studying the distribution of the acoustic field and determining the frequency characteristics of modulators for the purpose of rating the quality of modulators, as well as of apparatus for visualizing the acoustic field and for measuring the efficiency of acoustooptical elements. The results are presented of a study of the influence of the aperture number on the distribution of the field strength in the image plane in an optical acoustic wave converter. Data are given on the accuracy of the reconstruction of a sinusoidal signal after optical heterodyning by using photodiodes, made in Poland, which make possible up to 100-MHz modulation bands. The concept of the creation of planar radio optical devices is



discussed and it is reported that in Poland a technology has been mastered for fabricating waveguides by the diffusion of waveguides based on  $\text{LiNbO}_3:\text{Ti}$  into glass substrates of various types for creating parts of the functional elements of these devices. A theory has been developed for acoustooptical interaction in planar waveguides taking anisotropy into account. In planar acoustooptical modulators almost 100-percent efficiency of Bragg diffraction has been achieved at a frequency of 140 MHz and modulation has been accomplished at a frequency of 425 MHz with a modulation bandwidth of 15 MHz. It has been proposed to expand the modulation band by using planar lenses. Figures 12; references 24: 23 Polish, 1 Western.

[165-8811]

UDC 621.391

JOINING INDEPENDENT CHANNELS OF SIGNAL DETECTION IN BACKGROUND INTERFERENCE WITH UNKNOWN INTENSITIES ACCORDING TO MAXIMUM-LIKELIHOOD CRITERION

Moscow *RADIOTEKHNIKA I ELEKTRONIKA* in Russian Vol 27, No 1, Jan 82  
(manuscript received 27 Oct 80) pp 61-64

ZAKHAROV, S. I. and KORADO, V. A.

[Abstract] The problem of joining  $p$  channels for detection of a Gaussian noncorrelated random high-frequency signal in background Gaussian noncorrelated random high-frequency interference is solved, with an auxiliary classified instructive interference sample available in each channel. Both main and auxiliary interference samples are represented in the form of rectangular matrices,  $n \times p$  and  $N \times p$  respectively ( $i = 1, \dots, n$  - number of main sample,  $k = 1, \dots, N$  - number of auxiliary sample,  $j = 1, \dots, p$  - number of detection channel). When the channels are independent, then the likelihood function can be maximized for each. The maximum-likelihood decision rule is established on this basis and the detection characteristics are calculated by the Monte Carlo method, taking into account constraints on the range of definition of the two parameters: interference signal intensity and probability of signal presence characterizing the signal-to-interference ratio. The results are compared with those based on the chi-square distribution for a decision rule optimal with respect to these parameters. Each channel consists of a square-law detector, a noncoherent storage, a normalizer and a nonlinear element. All channels feed into a summator with a threshold device at the output. Figures 2; references: 3 Russian.

[176-2415]



# SEQUENTIAL DETECTION OF TRAJECTORY IN BACKGROUND RANDOM FLUX OF INTERFERENCE SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 28 Apr 80) pp 52-60

IVANCHUK, N. A.

[Abstract] The problem is to detect, in a nonobservable process, the trajectory of an object which appears at some instant of time  $\theta \geq 0$  in some region  $\Omega$ . This object has a random parameter  $\lambda \in \Omega$  with an a priori density distribution  $P_0(\lambda)$  changing in time so as to realize a Markov process with transient density  $P_T(\lambda|\lambda')$ . The distribution of the random instant of time  $\theta$  is also given. The problem is treated as a "distortion" problem and the decision rule reduced to calculation of the a posteriori probability of distortion (presence of the object) on each step of the sequential detection process. The detection algorithm is synthesized on this basis, with the a posteriori probability of object's presence compared with the detection threshold. The algorithm is subsequently simplified by discarding the least likely trajectories according to any of various available methods and thus devising some suboptimal algorithms. This principle of detection is also applicable to complex models of observable useful signals such as the Poisson model. Figures 2; references 7: 6 Russian, 1 Western in translation.

[176-2415]

# NOISE IMMUNITY OF DATA TRANSMISSION SYSTEMS WITH VARIOUS SYNCHRONIZATION VARIANTS

Moscow RADIOTEKHNIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 17 Apr 80) pp 3-11

SMIRNOV, N. I. and ZALICHEV, N. N.

[Abstract] A comparison is made of the noise immunity of data transmission systems with active and passive pauses with code-division multiplexing for a great number of users. The comparison is made by taking into account the mismatch in phase and delay of complex reference and received signals under conditions of phase-shift keying. A comparison of noise immunity in an information channel with an active pause is made for the synchronization variant employing an individual synchronizing signal and the variant which separates the synchronizing signal from the information signal. The noise immunity of data transmission systems with a passive pause is compared, as well as that of variant No 1 with an active pause and variant No 2 with a passive pause, as the most noise immune. It is demonstrated that a data

transmission system with an active pause makes it possible to achieve noise immunity greater than by an order of magnitude as compared with a data transmission system with a passive pause. The optimum variant is the coherent variant in which the delay tracking loop operates with reference to the information signal and the phase-locked loop to the synchronizing signal, on which about one tenth of the total power is used. This variant is a data transmission system with an active pause. With a combined fluctuation noise factor of 0.001 the number of elementary pulses in the train must be equal to or greater than 16,388. This is possible with the data transmission speeds of less than 1000 bauds for the digital integrated circuits now produced with a maximum speed of response of 20 MHz. The combined fluctuation noise factor mentioned represents a 1000-fold excess over the legitimate signal. Not taking into account the mismatch in terms of delay and phase of the complex reference and received signals in calculating the noise immunity of a data transmission system with code-division multiplexing can result in a 100-fold too low estimate of the probability of error in the information channel. Figures 4; references 10 Russian. [165-8831]

UDC 621.391.2

# USE OF COMPENSATION METHOD FOR DETECTING WEAK SIGNALS AGAINST BACKGROUND OF IMPULSE NOISE

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 4 May 81) pp 66-69

ANTONETS, M. A. and DUDIN, V. Ye.

[Abstract] A study is presented of the feasibility of employing the compensation method for the detection of weak signals against a background of impulse noise in the very-low-frequency (VLF) band. In this band the major contribution to noise is made by noise of electrical storm origin, which is of a nonstationary impulse nature, and by industrial noise. Noise from neighboring radio stations, which restricts the use of the compensation method in the traditional radio band, is absent in the VLF band. Sensitivity estimates show that the compensation method is more sensitive than the synchronous detection method and the ShOU [expansion unknown] method. The ShOU method, described in an earlier study (Chernyak, 1967), consists in the fact that the signal in the input of a narrowband filter, i.e., a synchronous detector, amplified over a wide band, is replaced by a constant value if it exceeds a certain level. The ratio of the variance of signals in the outputs of compensation and coherent receivers is used as the effectiveness criterion. This ratio makes it possible to estimate the ratio of the probabilities of false alarms and characterizes the change in the signal-to-noise ratio in the receiver's output. Measurement results are presented which demonstrate that the compensation method is more effective than the method of coherent accumulation with a sufficiently extensive range of noise parameters. The greater effectiveness of the compensation

method as compared with single-channel methods is caused by the presence of a considerable correlation of the envelopes of the noise in the input of two slightly overlapping band filters with close central frequencies. References 7: 6 Russian, 1 Western. [165-8831]

UDC 621.391.2

#### OPTIMUM FILTRATION OF MARKOV PROCESSES WITH DIFFUSION AND PULSE COMPONENTS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 28 May 79, after revision 17 Dec 80) pp 2089-2094

YERSHOV, L. A. and GOREV, P. G.

[Abstract] A 1979 work by V. I. Tikhonov and L. S. Yershov (see above) proposed a Markov model of a one-dimensional pulse random process with a continuous set of states, and obtained an algorithm of filtration of this process on a background of normal white noise. The present paper generalizes the results of this work for the case of filtration of a multidimensional continuously-valued process with diffusion and pulse components. The pulse components represent a succession of video pulses with random amplitudes, duration and intervals between pulses. Brief consideration is given to the use of the relations obtained for synthesis of quasi-optimum receiving devices for pulse signals. Here  $f(t, T) \cos \omega_0 t$  is the effective signal, which is a succession of radio pulses with a fluctuating repetition period  $T(t)$ . In the effective signal all the parameters other than the repetition period are constant and are considered to be unknown. A block diagram of the receiver is shown. Figures 3; references: 7 Russian. [138-6415]

UDC 621.391.31.029.5:621.319.925

#### HIGH-SPEED SYSTEM OF SIGNAL TRANSMISSION WITH BLOCKING INTERFERENCE

Moscow ELEKTRICHESTVO in Russian No 12, Dec 81  
(manuscript received 1 Jun 81) pp 19-24

GAL'PERSHTEYN, Ya. L., engineer, and MIKUTSKIY, G. V., doctor of technical sciences, Moscow

[Abstract] Systems of signals-commands transmission are widely used in protective relaying and antibreakdown automatic power systems. Basically, high-frequency communication channels along overhead electrical transmission lines are used in the USSR. The present work is concerned with obtaining quantitative relationships for calculation of the parameters and settings of

a system with blocking interference, and a comparison of the results obtained by experiments. The following items are considered: 1) Protection from the effect of intensive interference; 2) Determination of minimum permissible delay time in a delay circuit; and 3) Determination of minimum permissible excess of the signal level over the level of nonintensive interference. It is shown that the system of reception with blocking interference considered makes it possible with the use of a standard telephone channel to obtain a transmission rate 4 times larger than with the use of a system of wideband filter--amplitude limiter--narrowband filter [SHOU]. An increase of the transmission rate is achieved because of an increase of the minimum permissible value of the excess of the load of the signal received over the level of the nonintensive interference. In comparison with a SHOU system, this increase amounts to 10-12 dB. The most efficient use of the system considered for signals-commands transmission is in investigations of channels, the quality of which does not depend on the condition of the overhead line, e.g., radio relay channels and cable communication lines. Figures 5; tables 1; references 4: 3 Russian, 2 Western. [96-6415]

UDC 621.391:510.53

# CONNECTION OF THEORETICAL PRINCIPLES OF SOME CONTEMPORARY METHODS OF DIGITAL SIGNAL PROCESSING WITH CLASSICAL METHOD OF HARMONIC ANALYSIS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 18 Apr 80) pp 2141-2147

GUSEV, V. G.

[Abstract] Among contemporary methods of digital processing, one of the foremost places is rightfully occupied by frequency analysis of signals, instrumented with the aid of a fast Fourier transform algorithm. However, a statement of the theoretical principles of such an analysis for discrete signals, determined at finite intervals, does not result in a natural form of the overall positions of spectral theory. The present paper shows that the algorithm of frequency analysis used in digital processing realizes the classical problem of practical harmonic analysis of functions. Practical use is established for the concept of discrete sequence which is analyzed on the basis of a trigonometrical interpolational polynomial. Figures 1; references 9: 6 Russian, 3 Western (2 in translation). [138-6415]

## RESOLUTION OF UNKNOWN NUMBER OF SIGNALS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 21 Apr 80) pp 92-97

FAL'KOVICH, S. Ye. and KONOVALOV, L. N.

[Abstract] The problem is to determine the dimensionality  $N$  of the basis and the set of  $2N$  unknown parameters  $\{\alpha_i, \lambda_i; i = \overline{1, N}\}$  from function

$$f(\lambda) = \sum_{i=1}^N \alpha_i S(\lambda - \lambda_i) + n(\lambda) \text{ characterizing the input data (observations),}$$

where  $\alpha_i S(\lambda - \lambda_i)$  is the useful signal component and  $n(\lambda)$  is the interference component. Function  $S(\lambda)$  and the range of variables  $\alpha_i, \lambda_i$  ( $i = \overline{1, N}$ ) are a priori known. The problem is solved deterministically by forming a sequence of generalized parameters  $B_0, B_1, B_2, \dots$ , then constructing a matrix sequence  $\{B(kXk), k \leq 1, 2, 3, \dots\}$  and calculating the determinant  $\det B(kXk)$  ( $k = N$ ) of each matrix. Thus  $N$ , representing the number of signals, is determined by the rank of matrix  $B(kXk)$ . References 5: 4 Russian, 1 Western.  
[176-2415]

UDC: 621.396.43

## DIGITAL RADIO RELAY TRANSMISSION SYSTEM 'ELEKTRONIKA-SVYAZ'-11S' FOR INTRAZONE NETWORKS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 25 Jun 81) pp 17-19

KRAVCHUK, N. V., LEONOV, V. A., MARTYNOV, L. M., KOLOKOLOV, Yu. K.,  
SUKHOMLIN, K. B., FILIMONOV, A. R., IL'INSKIY, N. D. and GABUYEV, G. V.

[Abstract] The 'Elektronika-Svyaz'-11S" digital radio relay transmission system has been developed for multiple-link radio relay lines and can be used to organize telephone communication lines within oblasts with up to 10 links with a mean link length of 25 km. It includes a radio relay digital line unit and the "Zona-120" channel forming apparatus. Photographs of the equipment are presented. The equipment was exhibited at the world conferences "Telcom-79" and "Svyaz'-81", and is now undergoing experimental testing. Figures 2; references: 4 Russian.  
[193-6508]

## VARIATION OF ATTENUATION OF NONLINEARITY AS FUNCTION OF RADIO RELAY LINE APPARATUS LOAD

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 21 Jul 81) pp 20-24

SMANTSER, A. N.

[Abstract] The analysis presented in this work shows that monitoring the linearity of a radio relay line without interrupting communication can be performed at the cost of some complication in the test method. The specifics of radio relay line equipment are discussed, and the method of measuring the products of nonlinear distortion of a sine wave signal is outlined. The mathematical analysis demonstrates that attenuation of nonlinearity in harmonics is not an unambiguous criterion for line linearity in FM systems with frequency separation of channels. The variation in nonlinearity attenuation as a function of frequency and of multichannel message load can, however, be used for line evaluation purposes. The author thanks Ye. A. Bobrov and K. B. Tamamshev for fulfilling calculations on a computer, as well as L. B. Dobryakov for conducting experiments. Figures 3; references 6: 4 Russian, 2 Western (1 in translation).  
[193-6508]

UDC: 621.396.43:621.396.6.001.5

## CHARACTERISTICS OF HIGH-SPEED CENTIMETER BAND RADIO RELAY APPARATUS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 11 Aug 80) pp 25-27

PEVZNER, F. A., STRUGANOV, Ye. S. and KUZ'MINA, L. P.

[Abstract] A description is presented of transmitting and receiving equipment operating in the 10.7-11.7 GHz band, which can be used for transmission of digital and analog multichannel telephone signals (up to 1920 telephone channels) or a color television program plus two audio signals. The experimental studies of the system confirm its high effectiveness in transmitting digital information at 51.2 Mbps through a radio relay trunk and show the genuine possibility of creation of high-speed radio relay systems in the 11 GHz band. Figures 4; references 4: 3 Russian, 1 Western.  
[193-6508]



## POSSIBILITY OF USING FACSIMILE APPARATUS IN RADIO LINES

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 4 Nov 80) pp 14-16

VENSKAUSKAS, K. K.

[Abstract] Preliminary studies of the "shtrikh-M" facsimile apparatus were undertaken between the "Dunay" river vessel and the port of Izmail. A structural diagram of the apparatus used on board the ship and on the shore station is presented. Any radio apparatus can be used. The "brig" transmitter used radiates in class A3J with suppressed carrier, signal band width of 2350 Hz (350-2700 Hz), peak output power 1500 W in the 4-26 MHz band, 400W in the 1.6-3.8 MHz band. A "Sibir'" receiver was used on board the ship. The preliminary testing indicated that the apparatus works well with the meter and decameter band radio apparatus and can be used to exchange information through radio telephone channels. Figures 3; references 9: 3 Russian, 6 Western.  
[193-6508]

## EXPERIMENTAL PHOTOFACSIMILE APPARATUS WITH ADAPTIVE DELTA MODULATION

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 3 Jan 80) pp 12-14

KULIKOVSKY, O. V. and KOVALENKO, A. M.

[Abstract] Studies on the selection of the optimal method of digital modulation for photofacsimile transmission conducted by the Leningrad Institute of Electric Engineering have shown that differential pulse code modulation and delta modulation are most suitable. Delta modulation has the advantage of simplicity of implementation, particularly for the transmission of monochrome images. Adaptive delta modulation uses an increased spacing during transmission of boundaries and small details where distortions are less noticed because of masking and decreases the step in areas with constant or smoothly changing brightness where distortions are most easily noticed. Experiments have established that good reproduction quality can be achieved with several types of loops, with resolution never worse than 5 lines per millimeter at 120 lines per minute through a 9,600 baud line. Figures 4; references: Russian, 1 Western in translation.  
[193-6508]

## POSSIBILITY OF USING TELEVISION MICRORELAY AMPLIFIERS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 13 Mar 80) pp 39-41

KUZNETSOV, V. D.

[Abstract] Microrelay amplifiers consisting of directional receiving-transmitting antennas connected by cable through an amplifier are quite useful to fill in holes in television coverage in mountainous areas. The characteristics of such devices are calculated and optimal versions of their location such that areas of interference and reduced image quality are located where there are no receivers are discussed. A relay with an output voltage of 1 V, power 13 mW can serve an area of up to 15 square kilometers with a boundary field intensity of 0.5mV/m. Figures 4; references: 1 Western. [193-6508]

UDC 681.7.068.4

## MULTIPLE SPLICES IN OPTICAL TRANSMISSION LINE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 12 May 80) pp 11-19

MARTYNOVA, T. A., CHERENKOV, G. A. and SHEVCHENKO, V. V.

[Abstract] Fiber optics with a staircase profile obtained by splicing are considered and the losses at splices are evaluated through theoretical analysis of waveguide electrodynamics on the basis of Maxwell field equations with subsequent numerical analysis of pertinent relations. Calculations on a BESM-6 computer have yielded the dependence of the light intensity attenuation on the offset between axes of adjacent fiber segment, with the radius of the sender fiber equal to, larger than, or smaller than the radius of the receiver fiber, also its dependence on the difference between the refractive indexes of adjacent fiber segments without gaps, its dependence on the ratio of sender fiber and receiver fiber radii without offsets and gaps at splices, and its dependence on the number of splices connecting identical fiber segments without offsets but with gaps. Figures 7; references 10: 2 Russian, 8 Western. [176-2415]

UDC 621,372.04.75

ALGORITHM FOR CALCULATION OF SHIELDED STRIP, SLOT AND COPLANAR LINES

Kiev IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 17 Mar 80, after revision 27 Feb 81)  
pp 37-42

ARZHANOV, S. N., MARKOVA, S. A., RAYEVSKIY, S. B. and TIMOFEYEV, Ye. P.

[Abstract] An analysis of regular striplines is widely discussed in the literature. Nevertheless, it is of interest to investigate all possible approaches to the composition of an algorithm making it possible to conduct a calculation of both the dispersion characteristics and the fields of their fundamental waves, with the object of developing the optimum. In the present work, the principal merits of the proposed algorithm are shown to be: 1) Universality: the algorithm makes it possible to conduct a calculation of coplanar, slot and strip shielded lines with a finite thickness of the conductor; 2) A rapid convergence of the integral characteristics and fields is assured; 3) A high accuracy of calculation is assured in low-level approximations, in connection with which a large expenditure of machine time is not required (average time of calculation of one root of a dispersion equation written in a first approximation, on a BESM-4 digital computer amounts to 2.5 sec.; 4) The presence of analytical relations of the coefficients  $A_v$ ,  $A_v^*$ ,  $B_v$ ,  $B_v^*$  with residual amplitude coefficients assures the absence of supplementary (apart from those which originate during the solution of dispersion equations) errors during calculation of fields, and 5) The simplicity of presentation and calculation of fields in separated regions contribute to the effective use of an algorithm during solution of diffraction problems for shielded lines, during an investigation of attenuation in them and during calculation of the maximum transmittal power, Q-factor and the spectrum of oscillations of microstrip resonators.

Figures 4; tables 1; references 6: 4 Russian, 2 Western.

[91-A-6415]

## STRIPLINE RADIATION

Izv. IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 19 Sep 80) pp 32-37

PANCHENKO, B. A. and SHABUNIN, S. N.

[Abstract] In many practical constructions of stripline antennas, radiation is excited inductively or conductively from striplines. The radiation for such regular lines is heterogeneous. The effect brought to bear by it on the line indicates that a stray radiation of the incoming transmission line is introduced into the total field of an antenna. During calculations, the latter is either altogether not considered or is considered in an extremely approximate way. The object of the present work is to determine the quantitative characteristics of radiation of a stripline with arbitrary heterogeneity. Green tensor functions are used during expansion with respect to LE, LM type waves and expressions are obtained for radiation resistances of spatial and surface waves of striplines with arbitrary heterogeneity. The results of a calculation of the radiation pattern of these waves for two extreme frequencies of the range are presented on Figures 3 and 4, respectively, of the present work ( $\epsilon_1^1 = 5.0$ ;  $1-f = 5$  GHz;  $2-F = 25$  GHz). An investigation is made of the effectiveness of operation of a stripline with heterogeneity as a device for channelization of high-frequency power. Figures 4; references 6: 4 Russian, 2 Western (1 in translation).

[91-A-6415]

## DISPERSION CHARACTERISTICS OF COPLANAR, SLOT AND MICROSTRIP LINES

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81  
(manuscript received 14 Nov 80) pp 61-64

VOL'MAN, V. I., TSESLIK, P., graduate student, Poland, MEIS [Moscow Electrical Engineering Institute of Communications] and GAYSTER, M. Yu.

[Abstract] In spite of the fact a considerable number of works are devoted to coplanar, slot and microstrip lines, as yet simple analytical expressions for the propagation in them have not been obtained. Explicit expressions for dispersion characteristics of these lines are derived in the present short communication. A comparison is made of the results of calculation and experiment. Figures 5; references 6: 4 Russian, 2 Western.

[163-6415]

## ANALYSIS OF COPHASAL--ANTIPHASE DIRECTIONAL COUPLER WITH TRANSFORMATION OF RESISTANCE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 9, Sep 81 (manuscript received 25 Nov 80, after revision 19 Feb 81) pp 82-84

SHLEYE, V. R.

[Abstract] The present brief communication investigates the effect of the ratios of transformation on the functioning parameters of directional couplers (DC) with a centralized connection, which belong to the class of "ring-shaped" DC and are characterized by a larger bandwidth duration than codirected quadrature DC with a centralized connection. Cophasal-antiphase DC can have an infinite frequency--independent decoupling of the diagonal arms 1 and 2, as well as a frequency--dependent decoupling equal to infinity at the central frequency  $\omega_0$ . Consequently, for the investigations two realizations which find the most use in microwave techniques were selected: a ring-shaped DC with a length  $\Lambda$  ( $\Lambda$  = length of wave in line) which has a frequency--independent infinite decoupling, and a ring-shaped DC with a length  $1.5\Lambda$  (so-called "hybrid ring"), which is characterized by ideal coupling only at the central frequency  $\omega_0$ . It is shown that by means of a selection of the ratios of transformation it is possible to plan a DC, not inferior with respect to bandwidth duration of a DC without transformation of resistances. The investigated realization of a DC with transformation of resistances have a limited range of realization in stripline and microstrip line fulfillments. Figures 3; references: 5 Russian. [91-A-6415]

UDC 621.375.049.77

## ANALYSIS OF AMPLIFIERS BASED ON INTEGRATED CIRCUITS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81 (manuscript received 22 Dec 80) pp 37-43

LUR'YE, O. B.

[Abstract] An analysis of the circuit functions of amplifiers based on integrated operational amplifiers [OA] is substantially simplified if an OA which has three exterior units is considered as an active amplifier element which is determined by a matrix of conductivity of the third order. The present brief communication considers the circuit function of one and four OA. It is concluded that use of a matrix of conductivity of an OA makes it possible to obtain the circuit functions of amplifiers, taking account of the effect of the real parameters of the OA. Equations are

obtained for the transmission factors of the difference signals and signals of average level, and the input and output conductivities of amplifiers at one and four OA. The dependence is shown of the attenuation factor of a signal of an average level on the unbalances of the differential amplifiers and the possibility of its increase with specified unbalances. Figures 3; references 5: 4 Russian, 1 Western.  
[163-6415]



## COMPUTERS

UDC: 002.6:(681.31+621.397.6)

### INFAS INFORMATION SERVICING SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 10 Feb 81) pp 51-53

MALOVICHKO, V. V., FAYNERMAN, V. S. and ABRAMASHVILI, A. L.

[Abstract] Since late 1979, the INFAS (information-analytic service) has been in operation with 33 subscribers in Georgia. The system consists of 33 terminals and a minicomputer located 1 km distant from the INFAS hardware room. Any one of the 33 consumers can call the operator with a request for information or other simple computer services. The operator punches the request into the computer through her terminal, and directs the answer to the terminal of the requester. Future improvements planned include the ability to call an image of a microfiche document to the screen of each end user. Figures 4; references 2 (Russian).  
[193-6508]

UDC 621.37/39:534

### PROBLEM OF ELECTRON-ACOUSTIC MEMORY IN $\text{LiNbO}_3$

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 17 Mar 80) pp 2234-2236

VOROSHEN', V. I. and CHIRKIN, N. M.

[Abstract] In three works from the literature the possibility of realization of an electron-acoustic memory, i.e., entry and reproducibility of the charge pattern of a surface acoustic wave in a piezoelectric crystal by irradiation of its surface by an electron beam. The experimental data furnished in them was mainly obtained with the use of quartz crystals. The present brief communication investigates electron-acoustic memory in  $\text{LiNbO}_3$ . An experimental set-up, consisting of an electron beam with a directly heated tungsten cathode operating in a regime of separate "flashes" with a duration of 0.1-0.4 sec, and  $\text{LiNbO}_3$  plates of YZ cut with two interdigital

transducers, was mounted in a vacuum chamber. Entry and reproducibility of the charge pattern were accomplished at a 30 MHz frequency by pulse irradiation of the surface of the piezocrystal by an electron beam with a charge density up to  $3 \cdot 10^{-9}$  K/cm<sup>2</sup> with a duration of ~10 nanosec. Before mounting in the experimental unit, the surface of the piezo crystal plate was subjected for 2-3 min to ion-plasma purification in a glow discharge. Graphs are shown of 1) Dependence of amplitude of the reproduced signal on  $Q\bar{\Sigma}$  with the short term memory  $T = 1$  mc and various amplitudes; and 2) Losses in the cycle entry-reproduction  $A$ , as a function of the short term memory  $T$ . The experimental investigations conducted show that with the use of YZ-cut LiNbO<sub>3</sub> crystals, realization is possible of multipole reproducibility of the entered signal, during which the acceptable losses of 50-60 dB are reached with moderate density of the charge of the electron beams of  $1.6--2 \cdot 10^{-9}$  K/cm<sup>2</sup> (160-200 mA/cm<sup>2</sup>). Under the conditions of the experiment, the storage time reached 30 min. Figures 2; references 6: 5 Russian, 1 Western. [138-6415]

UDC: 621.317.7

#### PERIODIC BINARY SEQUENCE GENERATORS USING UNIVERSAL LOGIC MODULES

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 6 Feb 80) pp 54-57

MALEV, V. A. and FEL'GIN, L. M.

[Abstract] A nontraditional method of synthesizing binary sequence generators is suggested, based on the use of universal logic modules. The idea of the method is that the structure of the binary sequence is looked upon as an arbitrary  $n$ -bit boolean function  $f(X^n)$ , where  $f_j$  represent the values of a function in sets of values of the variables  $X^n$  and are used to adjust the module. Then a single element can form the entire set of binary sequences of length not over  $2^n$ . A structural diagram of a periodic binary sequence generator based on universal logic modules is presented. This method of forming binary sequences can be used to plan adjustable high-speed universal periodic binary sequence generators. The method of analysis and synthesis of such generators here presented is very simple, economical and allows the synthesis of binary sequences of any desired structure and length. Figures 4; references: 5 Russian. [193-6508]

## CONTROL SYSTEMS

UDC 621.396.662.072.6.078

### FILTRATION OF NOISE IN PULSE SYSTEM OF PHASE AUTOMATIC FREQUENCY CONTROL

Moscow RADIOTEKHNIKA in Russian Vol 36, No 12, Dec 81  
(manuscript received 13 Dec 80) pp 5-9

KALMYKOVA, O. L. and KULESHOV, V. N.

[Abstract] In the case of the use of pulse systems of phase automatic frequency control (PPAFC) to solve various radio engineering problems, an important question is the suppression of a system of noise entering into it externally or originating in itself. In a PPAFC a regular noise operates, which is caused by the pulse nature of regulation and by fluctuations. The possibility is considered of improving filtration by the introduction into the PPAFC of an additional phase regulation. The following items are studied: 1) Operational controls; 2) Filtration of exterior fluctuating noise; and 3) Filtration of internal noise. The analysis conducted shows that the introduction of additional phase regulation in the pulse system of phase automatic frequency control makes it possible to improve filtration of the exterior noise. Figures 3; references: 6 Russian.  
[163-6415]

## ELECTRICAL INSULATION

UDC: 621.315.2:573.312.62

### SPECIFICS OF INSULATION BREAKDOWN IN SUPERCONDUCTING CABLES

Moscow ELEKTRICHESTVO in Russian No 3, Mar 82  
(manuscript received 5 Nov 80) pp 20-24

VERSHININ, Yu. N., ZASLAVSKAYA, T. B. and SOKOLOVSKIY, V. L.

[Abstract] A simple method is outlined to allow estimation of the sequence of events in an electrical breakdown in the insulation of a superconducting cable. The phenomena which accompany electrical breakdown in gaseous helium are studied. Equations are presented for determining the intensity of the shock wave arising upon breakdown in liquid helium. The gas dynamic characteristics of helium after breakdown are computed for the use of non-inertial switching equipment. It is recommended that superconducting cables be created with the necessary reserve of mechanical strength to limit the area of fracture occurring upon breakdown, and that special measures and devices be used to limit the area of an electrical breakdown. Figures 1; references 11: 6 Russian, 5 Western (1 in translation).  
[196-6508]

UDC: 537.528/.529:621.3.015.51

### DIELECTRIC STRENGTH OF LIQUID AND SOLID ORGANIC DIELECTRICS UNDER PRESSURE

Moscow ELEKTRICHESTVO in Russian No 3, Mar 82  
(manuscript received 11 Aug 81) pp 54-55

MESENZHNIK, Ya. Z. and PRUT, L. Ya.

[Abstract] Studies were made of the variation in dielectric strength of electric insulation as a function of pressure and temperature. The studies were performed in an autoclave which allowed the pressure to be increased to 200 MPa and the temperature to 473 K. Both organic polymer dielectrics used for insulation of the windings of oil pumps and electric drills operating in transformer oil and the transformer oil itself, a component part of the motor insulation, were tested. Curves of the variation in dielectric strength as a function of pressure are presented. Dielectric

strength increases with increasing pressure at all temperatures tested. It is proposed that the increased dielectric strength of the transformer oil with increasing pressure probably results from a decrease in the size of bubbles present in the fluid. Figures 2; references 11: 10 Russian, 1 Western in translation.  
[196-6508]

UDC: 621.315.61.048.1

#### CREATION OF HIGH-VOLTAGE OXIDE INSULATION

Moscow ELEKTRICHESTVO in Russian No 3, Mar 82  
(manuscript received 24 Mar 80) pp 50-51

CHERNYSHEV, V. V. and SHVETSOV, G. I., Voronezh State University

[Abstract] Oxide insulation achieved by direct oxidation of the surface of a conductor or semiconductor is considered quite promising. The most common method of producing oxide insulation on metals and semiconductors is electrochemical oxidation with anodic polarization in a gas plasma or electrolyte solution. The oxide film produced may be solid or porous. Results are presented from studies to determine the variation in sparking voltage in solid oxide insulation on aluminum as a function of various factors. Oxidation of aluminum in aqueous solutions of boric acid with the addition of ammonia was used. The chemical composition of the bath, hydrostatic pressure, temperature of the electrolyte and pretreatment of metal surface were found to influence the quality and structure of the oxide insulation produced. Figures 3; references 7: 5 Russian, 2 Western (1 in translation).  
[196-6508]

UDC: 621.315.616(048)

#### IMMEDIATE PROBLEMS IN ELECTRIC INSULATION TECHNOLOGY TO SUPPORT ELECTRIC MACHINE BUILDING PROGRESS

Moscow ELEKTRICHESTVO in Russian No 3, Mar 82  
(manuscript received 7 May 81) pp 15-20

PETRASHKO, A. I., VNIIEIM (All-Union Scientific-Research Institute of Electric Insulating Materials)

[Abstract] The most important stages in the development of electric insulation in the past are briefly mentioned. This article then systematizes and analyzes the primary achievements in these areas over the past years at the All-Union Scientific-Research Institute of Electric Insulating Materials. The major stages of achievement include the creation of enamel varnishes for winding wires; the development of organosilicon binders; the creation

of thermosetting electric insulation; and the development of heat resistant synthetic films and papers for insulation. Tables present the compositions of various insulating materials including glass textolites, new laminated plastics and granulated pressed materials. The contribution of modern electric insulating materials to improvement in modern electric power equipment will increase with the development of new raw materials and semifinished goods which meet the increasing requirements for electric insulation technology. Figures 2; tables 7.  
[196-6508]

UDC 621.315.616:621.313.13

#### WAYS OF IMPROVING ELECTRIC STRENGTH AND LONGEVITY OF 'MONOLIT-2' INSULATION FOR LARGE ELECTRIC MACHINES

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 82  
(manuscript received 1 Jan 81) pp 51-54

VDOVIKO, V. P., candidate of technical sciences, SYAKOV, V. G.,  
MASLENNIKOV, K. N. and OGON'KOV, V. G., engineers

[Abstract] "Monolit-2" is a composite thermosetting insulation material made up of glass tape or cloth, mica and an epoxy compound and is being used more and more extensively in large electric machine building. Ways are discussed for improving the technology for manufacturing this material and of creating appropriate designs of insulation systems for windings to ensure maximum utilization of the electric strength and longevity properties of this insulation material. If this insulation is not manufactured properly gas spaces form in it which lower its electric strength and service life. Elongated wedge-shaped spaces are formed in the depth of the material in improper manufacture. Some of these spaces are as thick as the glass tape. These spaces form between tapes when they are wound, usually near the end of the tape and creases in it, creating so-called closed dielectric wedges. These gas spaces have minimum electric strength and partial discharges begin in them, which affect the insulation's longterm electric strength. The origin of partial discharges results in gradual breakdown of the insulation and the degree of breakdown depends essentially on the strength of partial discharges. Surface partial discharges which develop in elongated spaces and are of high intensity represent the greatest danger. These surface discharges are formed with a high tangential component of the electric field strength at the surface of a space. This tangential component is in turn caused by settled charges during partial discharge in the gas medium of the space and it is greater the higher the settled charge density. For the formation of surface discharges it is necessary that the spaces have a developed surface and partial discharges do not develop in inclusions with a limited surface. Therefore, reducing the thickness and surface of gas spaces results in restricting the possibility of the formation of surface partial discharges and thus in lowering of the probability of intensive failure of the insulation. It is recommended that the developed surface of spaces be



reduced by prepressing the insulation followed by impregnation of it with a compound under overpressure. The results are presented of a study of the influence of this method of treatment on the intensity of partial discharges. The experimental data demonstrate the effectiveness of the method. An analysis has shown that insulation is least reliable at the point where stator windings leave the slot in the active steel of motors and generators. The edge effect evidenced can be eliminated by creating a shoulder in the corner of the slot and filling it with insulation having a dielectric constant higher than that of the main insulation of the windings. Highly effective in this regard is filling the shoulder with AG-4S molding material with a dielectric constant of 10. This is done by placing small boxes at the ends of the stator's slot. Experience has demonstrated the effectiveness of the methods discussed here. Figures 6; references: 4 Russian.  
[167-8831]

UDC 621.371.332.4

#### TWO-POSITION EFFECTIVE SURFACE OF SCATTERING OF HETEROGENEOUS AXIALLY-SYMMETRICAL FORMATIONS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 19 Nov 79) pp 2223-2224

AVDEYEV, V. B., LIMONOV, Ye. A. and YARYGIN, A. P.

[Abstract] A number of works have determined the magnitude of the effective surface of scattering of heterogeneous axially-symmetrical dielectric formations for the case of combined reception-transmission. The present brief communication is concerned with the characteristics of scattering of such formations for the case of a diversity of reception-transmission. This is of interest for many practical applications (e.g., location, diagnosis). Figures 1; references: 8 Russian.  
[138-6415]

UDC 621.372.412

#### FEASIBILITY OF USING DIELECTRIC-DISK RESONATORS FOR FREQUENCY STABILIZATION IN MILLIMETER BAND

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 6 Aug 80) pp 173-174

GUDKIV, O. I., KONSTANTINOV, V. I., MASALOV, V. L., RI, T. Yu. and SMIRNOV, P. V.

[Abstract] An experimental study of dielectric resonator disks at cryogenic temperatures was made, for the purpose of establishing the feasibility of their use as frequency stabilizers in the millimeter band. Such a disk cut

from a sapphire single crystal, 10 mm high and 30 mm in diameter, was excited from a dielectric waveguide through a distributed coupling. Its Q-factor was measured within the 35-37 GHz frequency range and found to increase from  $5 \cdot 10^4$  at room temperature to  $10^6$  and  $4 \cdot 10^6$  at 77 K and 4.2 K respectively. The temperature coefficient of resonance frequency  $TK_{fr} = -TK_L - 1/2K_{1Q}TK_\epsilon$  ( $TK_L$ - temperature coefficient of linear expansion,  $K_{1Q}$ - figure of merit 0.8-1,  $TK_\epsilon$ - temperature coefficient of dielectric permittivity) was also measured and found to be  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-8}$  K $^{-1}$  at 300, 77, 4.2 K respectively. References: 6 Russian.  
[176-2415]

UDC 534.8:621.317.44.042

## THERMAL ACTIVATION APPROACH TO STUDYING NOISE IN FERROPROBE CORES

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 81 pp 49-51

GOROBEY, V. N. and GOROBEY, N. N.

[Abstract] Noise originating in the cores of ferroprobes during their cyclic magnetic reversal makes a major contribution to the additive error of precision ferroprobe magnetometers. A new thermal activation mechanism is suggested for the origin of fluctuations in the parameters of Barkhausen effects under nonstationary conditions in ferroprobes. Random thermal fields originate in the cores of ferroprobes during the cyclic magnetic reversal of the cores. It is demonstrated that in magnetic reversal two thermally activated processes compete: separation of a boundary from a dislocation as a result of which the boundary goes to the next dislocation, or separation of the boundary together with the dislocation from an effective obstacle, as the result of which the boundary moves to a new effective obstacle. Aggregates of impurity atoms can act as obstacles in annealed cores made of ferronickel alloys. The greatest spread in the values of Barkhausen effect parameters is observed when both processes are equally probable, a situation under which the level of magnetic noise in ferroprobes reaches a maximum. A description is given of the competition process and a determination is made of the conditions under which magnetic noise is maximum. Expressions are derived for the probability that during a certain period a sudden change in a boundary will take place. A dislocation moves across potential barriers because of thermal fluctuations. The displacement of a domain wall is also regarded as a thermally activated process. It is demonstrated that for the purpose of reducing the noise level it is necessary to eliminate one of the competing processes insofar as possible, i.e., to pin the dislocation. Dislocations can be pinned either by special heat treatment such as lowering the annealing temperature, and by preliminary plastic deformation of the cores used in ferroprobes. Measurements of noise levels in ferroprobes whose cores are made of different alloys and were heat treated at reduced and high temperatures are presented and demonstrate that the noise level is reduced when the heat treatment temperature is reduced to about 800 °C from an annealing temperature of 1000 to 1150 °C. To achieve a minimum noise level an optimum combination of magnetic and strength characteristics of the core material is necessary. Up until recently high-temperature annealing was recommended to achieve a low noise level. Figures 2; references 15: 12 Russian, 3 Western. [166-8831]

## ABSORPTION OF ELECTROMAGNETIC WAVES BY SHAFT-FERRITE STRUCTURE

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received 1 Apr 81) pp 38-44

BUDAGYAN, I. F., MIROVITSKIY, D. I. and PONOMARENKO, V. I.

[Abstract] A study is made of the possibility of wideband absorption of electromagnetic waves by a combined structure in the form of a ferrite film on which is placed a shaft array of conducting strips. The shaft array by itself can effectively absorb waves whose length is less than or approximately equal to the height of the array. A homogeneous film of ferrite of slight thickness lying on a metal reflector can provide a low reflection coefficient in some frequency bands. Added structures are placed on the ferrite film to expand this band into the high-frequency region. The results of precise calculations of the reflection coefficient of a shaft array without cutouts have shown that by selecting the parameters of the array it is possible to produce a reflection coefficient which is 20 percent lower in terms of amplitude in the wavelength range in which the reflection coefficient of the ferrite film itself is high. However, in the wavelength region in which the reflection coefficient of the ferrite film is low, the shaft array acts as a screen, i.e., the addition of a shaft array without cutouts to the film results in a higher reflection coefficient as compared with that of the ferrite film itself. This screening effect can be overcome by making small cutouts in the shaft array; absorption is reduced because the conduction of the shaft array in the horizontal direction is interrupted. A procedure is presented for calculating the effective dielectric constant of a close-mesh array with cutouts. Calculation results demonstrate that applying to the ferrite layer a shaft array with cutouts dramatically expands the frequency region in which the reflection coefficient is less than 20 percent. With an increase in wavelength the reflection coefficient approaches that of the ferrite film but there is a transition region of wavelengths in which the reflection coefficient is greater than 20 percent. Figures 3; references 8: 6 Russian, 2 Western (1 in translation).  
[165-8831]

UDC 621.318.3.001.24

## CALCULATION OF CLOSING DYNAMICS OF DIRECT-CURRENT ELECTROMAGNET

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 82  
(manuscript received 29 Sep 80) pp 48-51

BAKHVALOV, Yu. A., doctor of technical sciences, professor, LOBOV, B. N.,  
MOGILEVSKIY, G. V. and NIKITENKO, A. G., candidates of technical sciences

[Abstract] A careful study of the transient operating modes of an electromagnet and optimization of its parameters are necessary for the development

of quick-response electromagnetic devices having a long service life. A method for and some results of determining the dynamic characteristics of a fast electromagnet on the basis of raw data obtained in calculating the magnetic field are discussed. Dynamic characteristics are usually calculated on the basis of static quantities and dependences often found from a very approximate picture of the magnetic field in the electromagnet. The magnetic field is assumed to be plane-parallel because of the relatively small working gap of an electromagnet. It is assumed in addition that eddy currents are absent in a laminated core, that the magnetization curves of the ferromagnetic materials are univalued and that currents are distributed uniformly over current-carrying regions. The problem is solved in two steps: 1) From calculating the magnetic field a determination is made of the dependence of magnetic flux linkage and tractive force on the armature current and travel, and 2) dynamic characteristics are then found. The method of finite elements, which is applicable for geometrically complicated regions and inhomogeneous and nonlinear media, is used to calculate the magnetic field. A nonlinear partial differential equation is obtained which describes the distribution of the magnetic field taking into account the magnetic properties of the medium. Region S is broken down into finite elements, e.g., triangles, whose number, dimensions and position are in no way limited and whose sides coincide with the interfaces of media with different properties. The unknown function within each element is represented as a low-order polynomial and the coefficients of the polynomial are expressed in terms of values at the vertices of the triangular finite elements. A flowchart is presented for the algorithm for calculating dynamic characteristics and equations are given for determining the tractive force, dynamic processes in closing of the electromagnet and the magnetic flux linkage per unit of thickness of the electromagnet. An illustration is provided of the breakdown of one half of the calculation region of the electromagnet into triangular elements and the dimensions are given of two variants of an electromagnet having minimum time indicators with specific dimensions and other properties. Figures 6; references:

3 Russian.

[167-8831]

## ELECTRON DEVICES

UDC 528.71.117:666.189.2

### PRINCIPLES OF CONSTRUCTION OF FIBER-OPTICAL COMPENSATORS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 12, Dec 81  
(manuscript received 16 Mar 81) pp 9-11

YES'KOV, D. N., PETROVSKIY, G. T., SATTAROV, D. K. and NIKOLAYEV, N. V.

[Abstract] In observation devices, motion picture projectors with continuously moving photofilm, high-speed motion picture cameras and the like, stoppage with respect to reception of the image is necessary at the moment of recording or presentation of a moving image. For this, units for compensation of the motion speed of the image [MSI] are used, in which an objective, a flat mirror, a system of flat mirrors, a plane-parallel plate or an optical wedge are used. Problems of MSI are also determined with the aid of fiber-optical elements [FOE], which extend the possibility of creating new devices for varying purposes. The principles of construction of the devices with units for compensation of the MIS are fulfilled on the basis of FOE, considered in two examples. The authors thank M. Ya. Shul'man for organization of the measurements of the frequency-contrast characteristics of an optical compensator and for participation in these measurements. Figures 3; tables 2; references 14: 11 Russian, 3 Western in translation. [186-6415]

UDC 537.525

### EXPERIMENTAL STUDY OF DYNAMIC IMPEDANCE IN GLOW DISCHARGE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 12 May 80) pp 133-136

ARSEN'YEV, A. A., DEREVYANKO, V. F., KURSHEV, G. A. and SHAPOVAL, V. Z.

[Abstract] An experimental study of discharge dynamics in helium-neon gas was made to determine the effect of impedance variations on the performance of gas-discharge devices. Measurements were made in four 70 mm long tubes with diameters 1.4, 1.8, 2.1, 2.5 mm respectively and with the pressure



of the He:Ne = 7:1 mixture varied from 133 to 532 Pa. The discharge current was maintained within the 2-10 mA range, without natural oscillations of the discharge column, and modulated at frequencies from 50 Hz to 2 MHz. Both resistance and reactance were measured, the data plotted on X-R diagrams in the impedance plane. The form of all diagrams is the same for all discharge currents, gas pressures and tube diameters. The experimental results agree qualitatively with theoretical calculations in the inductive  $X > 0$  range of reactance. At frequencies above 0.2 MHz there appears a capacitive reactance, the crossover frequency not depending on external conditions. Above 1 MHz the dynamic impedance approaches the same value under all conditions. The authors thank V. Ye. Privalov for formulating the problem and helpfully discussing the results. Figures 5; references 9: 4 Russian, 1 Hungarian, 2 East German, 2 Western.  
[176-2415]

UDC 538.56:621.385.7

# ELECTRON CLOUD FORMATION IN CROSSED FIELDS ON MODEL OF VARIABLE-CHARGE PARTICLES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 1, Jan 82 (manuscript received 3 Feb 81) pp 6-14

LASHIN, A. M., LEYTAN, V. A. and ROSHAL', A. S., Institute of Engineering Physics, Moscow

[Abstract] A method of simulating the electron cloud formation in crossed fields of M-type devices such as magnetron diodes is described which covers the entire range of transient and steady-state interaction. The electrostatic Coulomb field is calculated without a quasi-periodic approximation. However, an initial threshold density of space charge between smooth electrodes is stipulated. The method is demonstrated on a two-dimensional model of interaction space between coaxial cylindrical cathode and anode, the process assumed not to vary along the axial coordinate. In addition to four fields (uniform axial magnetostatic field, electrostatic field due to constant anode potential, high-frequency electric field of forward and backward waves propagating in azimuthal direction, and electric field caused by space charge), there is also included bombardment of the cathode with resulting secondary emission. Single-charge electrons generated by thermal emission and ionization have a negligible effect on the rate of space charge buildup and have, therefore, been omitted from the model. Typical calculations were made on a BESM-6 computer, taking into account the statistical character of an electron cloud. Figures 3; references 8: 7 Russian, 1 Western.  
[194-2415]

SHIELDS IN TWO-DIMENSIONAL MODEL AND THREE-DIMENSIONAL MODEL OF  
CRYOTURBOGENERATOR

Novecherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 1, Jan 82 (manuscript received 21 Jul 80) pp 26-32

KOS'KIN, YURIY PAVLOVICH, doctor of technical sciences, professor,  
TROFIMOV, YURIY ALEKSANDROVICH, graduate student, TSEYTLIN, LEV ALEKSANDROVICH,  
doctor of technical sciences, senior scientist, all of Leningrad Institute  
of Electrical Engineering

[Abstract] A cylindrical a.c. cryoturbogenerator is considered with a shield around the stator made of an ideal ferromagnetic (in the radial direction) nonconducting (in the axial direction) material and a thin electromagnetic shield inside the rotor made of a nonmagnetic material. The effect of each shield on the magnetic field in the generator under steady-state conditions is analyzed on the basis of two models. In the two-dimensional model the axial field component is disregarded and higher space harmonics are included, except where they are also negligible without an external ferromagnetic shield. In the three-dimensional model both shields are assumed to be infinitely long and the axial field component is included, with higher space harmonics disregarded only in calculations for the external ferromagnetic shield. The effect of the internal electromagnetic shield on the stator resistance and reactance is found to be negligible so that the two-dimensional model is adequate here. Figures 1; references 4: 3 Russian, 1 Western.  
[174-2415]

UDC: 621.315.592

ELECTRICAL PROPERTIES AND ANNEALING OF DEFECTS IN GALLIUM ARSENIDE  
BOMBARDED WITH INTENSE INTEGRAL ELECTRON FLUXES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 1,  
Jan 82 (manuscript received 3 Sep 80, in final form 5 Feb 81) pp 36-39

BRUDNYY, V. N., KRIVOV, M. A., POTAPOV, A. I. and SHAKHOVTSOV, V. I.,  
Siberian Institute of Physics and Technology imeni V. D. Kuznetsov,  
Tomsk State University

[Abstract] A study is made of the variation of  $\rho(D)$  and  $\rho(T)$ , as well as the specifics of annealing of defects in crystals of GaAs bombarded with electrons ( $E = 2.2 : 2.3$  MeV), integral flux up to about  $10^{19}\text{cm}^{-2}$ . Crystals of n- and p- GaAs alloyed with Te or Zn to about  $10^{16}\text{cm}^{-3}$  were used, as well as semi-isolated gallium arsenide alloyed with Cr. The material was grown by the Chokhralskiy method. The appearance of an anomalous sector on curves

of  $\rho(D)$  was observed for the first time under these conditions. One characteristic feature of GaAs with a high content of defects is p conductivity near 300 K. Studies of isochronic annealing showed that n- and p- GaAs with small quantities of doping impurities when bombarded with large fluxes of electrons remain highly resistive even when annealed to 600°C, because of the formation of clusters of point defects. Figures 4; references 11: 4 Russian, 7 Western.  
[225-6508]

UDC: 621.315.592

STUDY OF STRUCTURE OF DEFECT CENTERS IN GALLIUM ARSENIDE BY  
PHOTOCAPACITANCE METHOD

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 1,  
Jan 82 (manuscript received 1 Sep 80, in final form 23 Feb 81) pp 48-53

GLORIOZOVA, R. I. and KOLESNIK, L. I., State Scientific-Research and  
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[Abstract] GaAs (Cr) is used as an example to study the structure of complex centers by photocapacitance spectroscopy. This method allows electron transitions related to a specific center to be recorded. The behavior of the steady value and kinetic parameters of the photocapacitance component at Schottky barriers Au-n-GaAs (Cr) was studied as a function of wave length in the 0.9-2.5 micrometer range. The model of a center suggested agrees well with the experimental data. The center in question is a complex defect, the process of ionization of which involves the participation of the nearby vicinity. The vicinity is involved at high levels of excitation, while at weak excitation levels transitions from the center into the conductivity zone predominate. The authors believe that the center's nature results from the presence of point structural defects in the crystal, generated upon introduction of the chromium. Figures 4; references 8: 7 Russian, 1 Western.  
[225-6508]

## DEFECT FORMATION IN HIGHLY DOPED SILICON UPON IRRADIATION

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 1,  
Jan 82 (manuscript received 23 Jun 80, in final form 6 Apr 81) pp 93-97

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[Abstract] A study is made of the specifics of formation of stable radiation defects upon irradiation of highly doped n- and p-silicon. The initial rate of elimination of carriers in n- and p-silicon, rate of introduction of defects, their energy position and capture cross section of the basic carriers were studied upon bombardment with electrons at  $E=7$  MeV. Analysis of the results indicates that the compensation of highly doped silicon results from the introduction of a new type of radiation defect with a deep level. The variation of carrier removal rate as a function of concentration of impurities or the position of the Fermi level measured at 78 K yields an increase in the effectiveness of introduction of new compensating centers as a function of level of crystal doping. Annihilation of the primary radiation defects is practically nil at  $n_0, p_0$  less than  $10^{17} \text{ cm}^{-3}$  at  $T$  not over 300 K. The introduction of known vacancy complexes does not define the rate of removal of carriers at concentrations  $n_0, p_0$  much greater than  $10^{17} \text{ cm}^{-3}$ . Figures 3; references 8: 3 Russian, 5 Western.  
[225-6508]

## ACCUMULATION OF POINT DEFECTS IN n-TYPE SILICON CONTAINING DISORDERED AREAS

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 1,  
Jan 82 (manuscript received 4 May 81) pp 140-143

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[Abstract] Crystals of n-type silicon (phosphorus concentration about  $4.4 \times 10^{15} \text{ cm}^{-3}$ , oxygen concentration about  $9 \times 10^{17} \text{ cm}^{-3}$ ) were bombarded with reactor neutrons in the dose interval from  $1.2 \times 10^{11}$  to  $4.4 \times 10^{14} \text{ cm}^{-2}$ , then with electrons with energy 3.5 MeV. A Schottky barrier was created by atomization of gold in order to produce DLTS spectra. The results produced are explained within the framework of the model of interaction between disordered areas and point defects. Vacancies and interstitial atoms introduced by electron bombardment in a crystal preliminarily bombarded with neutrons participate in the formation of complexes in the "undisturbed"

matrix, and also flow to the vicinity of disordered areas, complex multiple bombarded structures containing increased concentrations of the individual types of point defects. When the concentration of disordered areas is not too high, the effectiveness of introduction of point defects into the matrix can be considered practically independent of the radiation dose or electron bombardment of crystals not containing disordered areas. The authors thank L. S. Smirnova and A. I. Baranova for useful discussions. Figures 3; references 6: 4 Russian, 2 Western.  
[225-6508]

UDC: 621.315.592

#### MICROWAVE NOISE IN n-GaAs AT 77 K

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 1, Jan 82 (manuscript received 27 Mar 81, in final form 10 Jun 81)  
pp 167-169

MASLOV, A. I. and RZHEVKIN, K. S., Moscow State University  
imeni M. V. Lomonosov

[Abstract] Studies of the microwave noise in n-GaAs under electron heating conditions have revealed a mismatch in the measured noise temperature with the calculated electron temperature. This report presents the results of experimental studies of "longitudinal" noise in n-GaAs at 77 K in the 1-3 GHz range. Gallium arsenide microwave oscillator diodes with electron transfer (type AA 703) with homogeneous doping profile, electron concentration in the active area  $n_0 = 1-3 \cdot 10^{15} \text{ cm}^{-3}$ , and length of active area  $l=10 \text{ } \mu\text{m}$  were studied. The electrons were heated by direct current in the subthreshold mode. The noise temperature for 77 K throughout the entire range of bias voltages except for a small sector near zero exceeds the electron temperature. There is an area of retarded growth of noise temperature. Graphs of noise and electron temperature across the diode are presented for 77 and 300 K. Figures 1; references 9: 4 Russian, 5 Western.  
[225-6508]

## DECREASING RADIATION DAMAGE TO GaAs BOMBARDED WITH LARGE ION DOSES

Leningrad FIZIKA I TEKHNIKA POLUPROVODNIKOV in Russian Vol 16, No 2, Feb 82  
(manuscript received 22 Jun 81) pp 364-366

KALUGINA, G. F., KOMALEYEVA, F. N., MORDKOVICH, V. N., SUKHODREVA, I. M.  
and TEMPER, E. M.

[Abstract] A study was made of the influence of silicon, arsenic, helium and hydrogen ion bombardment doses on the degree of crystalline lattice deformation and IR absorption of GaAs. As the dose increases, the process of internal restructuring of defects begins to predominate over the process of accumulation of defects. This can lead to a decrease in the damage rate in the implanted zone. Figures 2; references: 4 Russian.  
[228-6508]

## BROAD-BAND ELECTROOPTICAL MICROWAVE LIGHT MODULATOR

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 24 Jul 80, after completion 26 Nov 80)  
pp 15-20

VOLKONSKIY, V. B., GAGIYEV, N. G., GOLOVKOV, A. A. and YAKOVLEV, V. V.

[Abstract] The most important characteristics of broad-band electrooptical modulators (EOM) of light intensity are the operating range and the boundary frequency of microwave signal modulation with which it is possible effectively to operate the modulator. During excitation in the electrooptical crystal of the standing wave of the pulsing voltage, the boundary frequency of the modulator is determined by the characteristics of the crystal and its geometrical dimensions and the range of operating frequency, and besides that depends on the fulfillment of a correcting circuit coupling the electrooptical crystal with the source of microwave signal modulations. The object of the present work is to determine relative relations coupling the greatest possible depth of light modulation with the given parameters of a crystal and the power of the signal modulation with an operating frequency band and the structure of a correcting circuit. These relations can also be used for solution of the inverse problem--determination of the limiting operating ranges and the structure of the correction circuit for given levels of depth of the light modulation, power of the signal modulation and the parameters of the electrooptical crystal. Partial variations of such relations are obtained in the literature. A generalized circuit of an EOM is presented and explained. During the analysis dielectric losses in the electrooptical crystal at the frequency of the signal modulator are disregarded. A comparison of the light modulators with various types of correcting circuits is made. Figures 3; references 5: 4 Russian, 1 Western in translation.  
[91-A-6415]



## ELECTRODE EFFECTS IN MOS-STRUCTURES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 15 Oct 79) pp 178-180

ARISTARKHOV, A. I., KARMANOV, M. V. and URITSKIY, V. Ya.

[Abstract] Anodic polarization of silicon generates surface states at the Si-SiO<sub>2</sub> boundary in MOS structures and under certain conditions annihilates them when their density is high. A study was made in order to produce specimens with various controlled densities of surface states. The effect of anodic polarization produced by the two opposing mechanisms was found to depend on the initial condition of the Si-SiO<sub>2</sub> interface, on the morphology of the metal-oxide interface and on the temperature of the anodically polarized silicon. Annihilation of surface states is most intense in structures with an Al electrode and least intense in structures with polycrystalline Si as the control electrode, vanishing completely in the presence of a 400-600 Å Si<sub>3</sub>N<sub>4</sub> interlayer between SiO<sub>2</sub> and the control electrode (Al, Mo). The authors thank V. A. Mel'nitskiy for measuring the electrical characteristics of MOS specimens with a Si<sub>3</sub>N<sub>4</sub> layer, Ye. V. Kas'yanenko for polarizing the oxide-semiconductor structures in an electrolytic bath, and Yu. V. Fedorovich for helpfully discussing the results. Figures 2; tables 1; references 9: 2 Russian, 7 Western.  
[176-2415]

## UPPER SMALL-SIGNAL FREQUENCY LIMIT OF GUNN EFFECT IN n-GaAs

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 18 Feb 80) pp 186-187

BELOUSOV, N. P., MARTYNENKO, Ye. I. and CHAYKA, V. Ye.

[Abstract] The upper frequency limit of the Gunn effect in n-GaAs in the polyharmonic mode can be raised appreciably above its upper frequency limit (100-125 GHz at T = 300 K) in the large-signal mode. Theoretical calculations to estimate its upper frequency limit in the small-signal mode, namely the upper frequency limit for a negative differential conductance, were made by the multiparticle Monte Carlo method on the basis of the two-valley model of the energy-band structure, taking into account the nonparabolic dip in the frequency characteristic and the dependence of the periodic Bloch function multiplier near the minimum on the wave number. These calculations for various grid temperatures have yielded upper small-signal frequency limits of 180 GHz at 300 K and 140 GHz at 475 K. Figures 2; references 4: 1 Russian, 3 Western.  
[176-2415]

## MEASUREMENT OF NOISE OF ELECTRON-OPTICAL IMAGE CONVERTER TUBES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 12, Dec 81  
(manuscript received 29 Jul 80) pp 6-9

MATSKOVSKAYA, Yu. Z. and SAVENCHUK, N. A.

[Abstract] The paper describes methods and equipment for measurement of the signal-to-noise ratio and the noise factor of electron-optical image converters [EOIC]. It is shown that the feasibility of measuring the noise of EOIC makes it possible more effectively to conduct by an objective method an evaluation of the threshold characteristics, as well as to check the production technology of EOIC and to control it. A method of obtaining single electron amplitude distributions, described in a 1972 report by N. K. Pollehn, requires a more complex equipment and a higher qualification of the operator than measurement of the signal-to-noise ratio. Consequently, it is advisable to conduct such measurements during working off of the production technology for new types of articles and for research goals. In the case where it is necessary to evaluate a local or general quantity of scintillations with a specified level of brightness it is possible to employ the simpler equipment and procedures discussed in a 1975 report by A. Ye. Melamid and others, using light flashes based on a light-emitting diode for calibration of the amplitudes of the scintillations. The methods and equipment for measurement of the signal-to-noise are simple and with corresponding automatization are used for sorting out of EOIC in production conditions. Figures 3; references 8: 1 Russian, 7 Western.  
[186-6415]

## THEORETICAL ANALYSIS OF AMPLIFICATION IN TRAVELING WAVE TUBE OF MULTIFREQUENCY SIGNAL ON BACKGROUND OF NOISE

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 12, Dec 81 (manuscript received 17 Jun 80, after revision 23 Jan 81) pp 3-9

ALGAZINOV, E. K. and BOBRESHOV, A. M.

[Abstract] During amplification of two signals at the inputs of a TWT, the powers of which are substantially different, a suppression of the weaker signal takes place. This process has been sufficiently well studied at the present time. However, under real conditions the weaker signal is amplified on a background of noise, both from the exterior entering at the input of the amplifier together with the signal, and from the internal generated in the TWT. In this connection, from the energy point of view it is necessary

to have information, not only concerning suppression of the signal but also concerning the change of noise. The present work is devoted to an analysis of these phenomena. The following points are examined: 1) Representation of noise; 2) Change of level of internal noise of TWT in nonlinear mode; and 3) Change of level of exterior noise of TWT output in nonlinear mode. It is concluded that: 1) Under the effect of an intensive signal suppression in a TWT of internal signal, suppression in a TWT of internal noise takes place to a lesser degree, in comparison with suppression of a weak signal. Difference in suppression leads to a deterioration of the signal-to-noise ratio at the TWT output. It is possible not to consider combination noise which is produced as a result of the interaction of the intense signal and the components of the internal noise; 2) Suppression of the exterior noise and the weak signal takes place to an equal degree. In the resulting combination noise it is only necessary to take into account components of the form  $\omega_t = 2\omega_0 \rightarrow \omega_k$ . Suppression of this noise impairs the output signal-to-noise ratio at 3 dB with the power of the intense signal corresponding to saturation of the TWT; and 3) A simultaneous change of the level of the weak signal and the interior noise as well as suppression of the intermodulated noise leads to an increase of the noise factor of the TWT. The last conclusion, of course, results from the first two, because the level of the signal and the exterior and interior noise enters into an expression for the noise factor. A 1980 report from the literature gives a formula which takes into account the change of the noise coefficient in the presence of intense interference and a quantitative evaluation of the effect. The theoretical dependences obtained in the present work were obtained experimentally.

Figures 1; references: 7 Russian.

[153-6415]

UDC 621.385.632.2

#### SPACE-CHARGE FORMATION IN M-TYPE DEVICES WITH SECONDARY-EMISSION CATHODE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82

(manuscript received 8 Jul 80) pp 151-157

MAKAROV, V. N., GAYDUK, V. I. and MARIN, V. P.

[Abstract] Forces forming the space charge near a secondary-emission cathode in plane M-type devices are calculated theoretically by a simple approximate method. The average-in-time space charge is assumed not to vary along the transverse coordinate in the direction of the magnetic field vector within the interaction space. The interaction space is subdivided into  $n$  segments along the coordinate normal to both electric field and magnetic field vectors, the length of each segment equal to one slow-wave wavelength. The space-charge formation process is calculated starting from the first segment, where the intensity of the high-frequency magnetic field is equal to the intensity of the input signal field at either anode or cathode, and the space-charge density is determined from the density of the thermionic emission current.

The results of numerical evaluation indicate that the maximum space-charge density does not exceed 50% of the Brillouin density. Depending on whether a current dip occurs or not, the space-charge density in the cathode region ceases to build up as the average-in-phase initial secondary-emission factor becomes  $\sigma = 1$  or  $1 < \sigma < \sigma_{\max}$  respectively. The magnitude of the maximum space-charge density depends largely on the magnetic field intensity, the anode voltage and the secondary-emission characteristics of the cathode. Only the length of the space-charge formation region depends on the density of the thermionic emission current. An additional high-frequency retarding field at the cathode does not affect secondary emission but alters the mode of excitation of the field induced by the electron beam at the anodic retardation system. Figures 3; references 4: 3 Russian, 1 Western. [176-2415]

UDC 621.313.84

WAYS TO INCREASE SENSITIVITY AND INTERFERENCE IMMUNITY OF METAL DETECTORS

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 1, Jan 82 pp 20-25

SHALYGIN, IGOR' VLADIMIROVICH, candidate of technical sciences, docent,  
OL'SEVICH, AL'BERT YEVSTAF'YEVICH, candidate of technical sciences, docent,  
BOGOMYAGKOV, YURIY VALENTINOVICH, engineer, "Start" Public Design and  
Technological Office, BELOZEROV, YEVGENIY ANDREYEVICH, engineer, "Start"  
Public Design and Technological Office, all of Novocherkassk Polytechnic  
Institute

[Abstract] Failure-free mechanization and automation of raw materials processing largely depends on preventive detection and removal of detrimental metallic inclusions and stray particles. A general-purpose metal detector for a wide range of industrial applications is described which consists of an inductive probe in the form of a dielectric cylinder inserted into the conveyor with coils wound around the lateral surface inserted into the circuit of an a.c. generator. The sensitivity and interference immunity of such a device can be increased by first equalizing the electromagnetic field within the inspection zone and calibrating at the center of the probe, where the sensitivity is inherently lowest, then processing the transducer signal with appropriate logic circuitry. False alarm can be eliminated by addition of a second channel with a differential probe. Automatic tuning to a given technological process can be achieved by addition of velocity feedback. Figures 2; references 4: 3 Russian, 1 Western. [174-2415]

## UNDervOLTAGE PROTECTION OF STORING CAPACITORS FOR CONTROL OF HIGH-VOLTAGE THYRISTOR BANKS

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 82  
(manuscript received 15 Jul 81) pp 22-24

MATVEYEV, V. V., engineer

[abstract] Modern high-voltage thyristor banks are controlled by pulses from storing capacitors which have been charged from a battery through resistors of a voltage divider. Most efficient is a control network with two storing capacitors charged in push-pull and discharged in series. The network includes two stbilitrons from limiting the maximum voltage across capacitors, a switch between both capacitors and diodes for each in addition to a common RC charging circuit. Undervoltage protection is also included, disconnecting the thyristor bank so as to avoid loss of controllability and subsequent breakdown. The protection system consists of a reversible counter with an adding input and a subtracting input, pulses to the former being fed from a reference-pulse shaper through an inhibitor and a frequency divider, pulses to the latter being fed from a control-pulse shaper through a code-to-period converter and another frequency divider. The reference-pulse shaper receives input signals, through a switch, from a sine-wave voltage generator which is synchronized with the thyristor voltage. The outputs of the reversible counter are connected to the corresponding inputs of the code-to-period converter and a decoder. Figures 2; references 4: 3 Russian, 1 Western.  
[175-2415]



## INSTRUMENTATION & MEASUREMENTS

UDC 534.22.08-8:620.179.6

### DIGITAL ACOUSTIC NONDESTRUCTIVE INSPECTION INSTRUMENT

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 81 pp 52-53

SHTEYNBERG, V. E., KONOVALOV, S. N. and GALIYEV, R. V.

[Abstract] Instruments based on measurement of the propagation time of acoustic vibrations are being used experimentally for the purpose of testing the physico-mechanical characteristics of products made of fluoropolymers. The phase state of a polymer at the ambient temperature is taken into account by measuring the ratio of propagation rates in the working sample and a reference sample. The digital value of the parameter being checked is a function of the digital values of the propagation time in both samples. The instrument is simplified because the size of the base for the propagation of acoustic vibrations for products of a single type is taken into account automatically. In the measurement cycle working products are fed to concentrators, the acoustic vibration propagation time in the working sample is measured and the propagation time ratio is converted by means of a digital converter into an intermediate frequency which is measured in a readout unit. In the calibration cycle the reference sample is set on the concentrators and it is probed, after which the code for the propagation time for acoustic vibrations in it is copied from a counter into a memory and is set in the inputs of an amplifier leading into the digital converter. The calibration cycle is repeated every 1 to 6 h. The maximum error of the digital converter is 0.02 percent. A noise-immune shaper-amplifier shapes the signal of the pickup transducer into square pulses which are matched with transistor-transistor logic levels. The shaper-amplifier consists of an amplifying stage employing a K284UD1A microcircuit, a threshold device utilizing a K140UD2 microcircuit and a matching stage utilizing a KT342A transistor. Feedback loops are employed in such a manner that the first negative pulse in the output of the shaper-amplifier is formed from the first negative half-wave of the pickup transducer's signal, whose amplitude equals 0.5 mV. Input circuits and the entire shaper-amplifier are electrostatically shielded to protect from noise. The ratio of the digital equivalents of the acoustic vibration propagation times takes on values over the range of 0.85 to 1.05 with a mean value of 0.92. Figures 3; references: 4 Russian. [166-8831]

## TESTING WIDE-RANGE PHASE DIFFERENCE METERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 81 pp 43-45

PYATIN, S. I. and RUDYK, V. D.

[Abstract] A description is given of a method of testing broad-frequency-range phase difference meters which has been used to create simple test instruments. The method is based on using a test signal which makes it possible to simulate a specific phase shift. For phase difference meters which convert the phase shift into a time interval and which employ a trigger circuit this signal is an intermittent sinusoidal voltage in the form of a periodic sequence of coherent segments of harmonic oscillations. When the signal is absent the measuring trigger goes into one of its stable states. The voltage across its output is a sequence of a series of pulses interrupted for the period of the pause. The polarity and form of the signal in the trigger's output vary as a function of the value of the phase shift measured and this results in a change in the direct component of the pulse train. An equation is given which illustrates the dependence of the meter's readings on the parameters of the test signal. It is shown that it is possible to produce any phase shift value over a range of 0 to 180 degrees. It is also shown that with an appropriate value of the pulse-period-to-pulse-duration ratio of the test signal the meter can be tested at any point on its scale and with an frequency of the signal. The lower limit of the frequency range for which the method can be used is 1 kHz, and the upper range is practically unlimited to include the microwave band also. A block diagram is presented of an instrument which implements this method and utilizes series-produced equipment. It includes a sine-wave oscillator, an intermittent sinusoidal voltage former, a decade precision pulse generator, a phase inverter and a meter. The frequency of the signal is determined by the sine-wave oscillator and the parameters of the test signal by the pulse generator. The best choice for implementing the intermittent sinusoidal voltage former is one based on a 4-diode bridge circuit controlled by pulses of differing polarity applied to the bridge's arms. The sign of the phase shift is changed by switching the input of the phase meter to which the test signal is supplied. A block diagram is also given of a special instrument which can be used when for some reason it is not suitable to use standard measuring equipment. This instrument contains a sinusoidal signal source, an intermittent sinusoidal voltage former, a trigger, a counter with a decoder and a counter with a fixed counting factor, a Schmitt circuit, a quartz oscillator and a phase inverter. A signal enters an input of the test signal former from the sinusoidal voltage source and to its other input is fed a video pulse train with specific parameters. This train is formed when a signal from the quartz oscillator, converted by the Schmitt circuit into a meander, simultaneously enters the inputs of the two counters. This instrument can test an angle as small as 1 degree. The test error is not greater than 0.3 degree when testing an F2-13 phase difference meter over the frequency range of 1 kHz to 1 MHz. Figures 3; references: 4 Russian.

[166-8831]

## MAGNETICS

UDC 621.317.421.001.24

### CONDUCTING DISK IN HIGH-FREQUENCY FIELD OF COIL

Moscow ELEKTRICHESTVO in Russian No 12, Dec 81  
(manuscript received 24 Jul 79) pp 67-68

SEGAL', A. M., candidate of technical sciences, Leningrad

[Abstract] The present work considers a calculation of the distribution of magnetic induction with respect to the working and reverse surfaces of a disk located in the high-frequency magnetic field of a coil of infinitely small cross section. Under the working surface, a surface is implicit, turned to the coil. In the calculation the finite dimensions of the disk are considered, which makes it possible to evaluate their effect on the distribution of the field. Expressions are obtained for the limiting case of a high-frequency where the field practically does not penetrate into the disk. Curves are shown of the distribution for the working and reverse surfaces of the magnetic induction with respect to the radius of a disk with the coordinates  $\xi = 0.6$  and  $\eta = 0.667$ . Figures 2; references:

6 Russian.

[96-6415]

## PROCEDURE FOR RECORDING MICROWAVE SPECTRUM

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 12, Dec 81 (manuscript received 15 Apr 80) pp 58-60

SHCHERBOV, V. A. and SAVCHENKO, V. N.

[Abstract] The principles of operation of the procedures considered for spectral measurements described in a 1979 patent by V. A. Shcherbov and V. N. Savchenko (see above) involve the following points. The radiation in question in the range of microwave frequencies converts to low intermediate frequencies which depend on the frequency of the radiation received. This is accomplished with the assistance of a special frequency-dependent frequency-shift unit. A simplified block diagram of an installation for recording microwave spectrum, fulfilled on the basis of a quasi-optical transmission line and quasi-optical radio measuring devices, is presented and explained. In order to evaluate the frequency resolution of the procedure, experimental measurements were made of the dependence of the intermediate frequency on the wavelength of the microwave signal at the input of a frequency shift unit in the vicinity of one of the wavelengths ( $\lambda = 1.77$  mm). During measurements at the input of an antenna, microwave oscillations were fed from the microwave generator under adjustment. The signal power was kept constant. A crystal detector was used as a mixer. Calibration of the sensitivity of the detector and support of a constant level of the microwave signal power in a range of waves of interest were performed with the assistance of a broad-band pyroelectric detector. The wavelength was changed in the limits 1.6-1.9 mm and the signal was identified of the intermediate frequency of the output device of a selective amplifier (U2-6) tuned to a frequency of 1.6 kHz. The measured amplitude-frequency characteristics of the device are presented in a figure. With the use of a sufficiently broad-band channel it is possible to conduct recording of the spectrum of microwave radiation in the 0.5-2 mm wave band with sufficiently good resolution. Figures 2; tables 1; references: 6 Russian.  
[153-6415]

## RF-SQUID CHARACTERISTICS IN HIGH-FREQUENCY LIMIT

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 1 Jul 80) pp 2178-2186

SNIGIREV, O. V.

[Abstract] The goal of this work is a step-by-step theoretical analysis of the processes in a single-stage microwave SQUID (Superconducting Quantum Interference Device) in the event of  $l, \omega \gg 1$  and  $l \leq 1, q \gg 1$ , finding its characteristics, and comparing the minimum values of the magnitude  $\delta E$ , attained under various operating conditions, which makes it possible to obtain a general concept of the maximum possibilities of single-stage SQUIDs. The following items are considered: 1) General relations; 2) Amplitude-frequency characteristics of SQUID in regime  $l, \omega \gg 1$ ; 3) Radio-frequency and signal characteristics; 4) Threshold sensitivity; 5) Optimization of threshold sensitivity; and 6) High-frequency anhysteretic regime ( $l \ll 1, l\omega \gg 1$ ). It is shown that in single-stage SQUIDs the optimum values of the energy sensitivity are obtained with  $l \sim 1$ , independently from the values  $F/F_C$  and have the magnitude  $K_B T/F_C$ . The author deeply thanks K. K. Likharev for the numerous discussions which contributed to writing the work. Figures 5; references 14: 5 Russian, 9 Western.  
[138-6415]

## THEORY OF MICROWAVE SQUIDS WITHOUT RESONATORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 14 Nov 80) pp 2186-2195

KORNEV, V. K. and SNIGIREV, O. V.

[Abstract] The goal of this work is a step-by-step theoretical analysis of the processes in a microwave SQUID (Superconducting Quantum Interference Device) without a resonator in an approximation of a quasi-harmonic voltage at a Josephson contact, finding its limiting characteristics and comparing the properties of microwave SQUIDs with and without resonators. The following items are considered: 1) Equivalent circuit and basic equations; 2) Signal characteristics; 3) Noise characteristics; and 4) Comparison of SQUIDs with and without resonators. The theoretical analysis performed shows that a microwave SQUID without a resonator, in a regime of quasi-harmonic voltage at a Josephson contact is a means of assuring high resolution with respect to energy at a satisfactorily high frequency of the signal received, close to the maximum attainable with the aid of SQUIDs. The comparison made of the parameters of microwave SQUIDs, with and without resonators, shows that a SQUID without a resonator operates in a regime corresponding to the case of

$K^2Q \sim 1$ ,  $K^2 \ll 1$ . The authors are deeply grateful to K. K. Likharev for valuable comments and discussion of the results of the work. Figures 4; references 11: 5 Russian, 6 Western.  
[138-6415]

UDC [621.38.082.97-681.3.089.97:1025.4

#### CLASSIFICATION OF MICROELECTRONIC ANALOG-DIGITAL CONVERTERS

Moscow IZMERITEL'NAYA TEKHNIKA in Russian No 12, Dec 81 pp 41-43

TELETS, V. A.

[Abstract] It is suggested that modern microelectronic analog-digital converters (ADC's) be classified according to at least two combined features--method of conversion and functioning particulars. This is an approach which has been used for angle-code converters. In terms of method of conversion ADC's are divided into four main groups: serial, parallel, serial-parallel and programmable. In serial ADC's the input analog signal is divided into a number of values which are then either counted or compared with reference values. They are therefore subdivided into counting and comparison converters. Serial counting ADC's are in turn divided into cyclic converters and converters with storage. In the latter increments of the input signal are summed and in cyclic ADC's the input signal is converted during a specific time segment called a cycle during which it is analyzed and measured. Cyclic ADC's are further divided into those with intermediate conversion of the input signal into a signal of an individual frequency and then into square pulses which are counted over a certain time interval, and those without intermediate conversion, as a rule designed according to the single-cycle integration principle. Serial ADC's of the comparison type are subdivided into converters without a feedback loop and with a feedback loop covering the entire conversion circuit. The latter are subdivided into those which take into account the weight of bits and those which sum unit increments. A fourth major category of the classification of ADC's according to method of conversion is serial-parallel ADC's, which are further subdivided into ADC's with constant thresholds and with variable thresholds. In the former two or more parallel ADC's operate sequentially with respect to time, whereby the first ADC produces  $n$  higher-order bits of the output code and the digital data then enters the input of a digital-analog converter whose result is compared with the input signal, after which the remainder enters the input of another ADC to obtain  $m$  lower-order bits of the output code. In the variable-threshold type each bit for conversion has its own comparator. The threshold voltage of the comparator for the higher-order bit is constant, equal to half of the reference voltage, and the operating threshold of the second comparator is varied by means of a single-bit digital-analog converter controlled by the first comparator. Qualitatively speaking, programmable ADC's are a new class of converter representing multifunctional converters containing equipment enabling program control of operating modes and of the



conversion process and of the data exchange procedure. In terms of functioning features, ADC's are classified according to functional completeness, type of input signal, kind of digital code, polarity of the input signal, number of channels, speed, precision, interfacing capabilities, type of triggering and resistance to external influences. Concise statements are made on each of these features. The advantages and disadvantages of the various methods of conversion are briefly summarized. Figures 2; references 16: 14 Russian, 2 Western.  
[166-8831]

UDC: 621.354.76

#### NOISE PROPERTIES OF MICROWAVE TRANSISTORS

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 82  
(manuscript received 19 Nov 79) pp 57-60

KURUSHIN, A. A. and TEKSHEV, V. B.

[Abstract] A method is studied for describing the primary noise parameters of microwave circuits, as well as a method of measurement and computation of these parameters using a complete equivalent circuit. The relationship among parameters in various circuits is determined. The noise properties of the transistor are represented by a theoretical noise factor and a noise measure. The use of the parameters of microwave transistors in the T system (transmission rather than scattering) significantly simplifies experimental determination of primary noise characteristics and analysis of the noise characteristics of multistage amplifiers. The equations derived in this article can be used to estimate the noise properties of transistors in various circuits, facilitating the selection of an amplifier circuit with fixed noise characteristic requirements. Figures 2; references 9: 7 Russian, 2 Western in translation.  
[193-6508]

UDC 621.372.2.001.24

#### DIFFRACTION IN STRIP STRUCTURES: ANALYSIS OF MICROWAVE INTEGRATED CIRCUITS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 24, No 12, Dec 81  
(manuscript received 27 Feb 81, after completion 30 Jul 81) pp 1423-1458

NIKOL'SKIY, V. V. and NIKOL'SKAYA, T. I., Institute of Radio Engineering, Electronics and Automation, Moscow

[Abstract] A discussion is presented of the general principles of the design of electrodynamic models of strip structures for microwave integrated

circuits, and a summary is given of results obtained hitherto. Typical difficulties in algorithmization are also discussed. It is felt that development of the electrodynamic theory of strip structures will result in the construction of proven mathematical models for automated design systems. Fundamental to the electrodynamic theory is the decomposition principle, which makes it possible to formulate problems not for objects of great configurational complexity, but for relatively simple parts of them while preserving all "broken" connections in the final model. In the electrodynamic theory microwave integrated circuits are given a diffraction interpretation, i.e., the appearance of diverging waves in all connected channels with the presence of conceivable incident waves is discussed. A multimode scattering matrix which juxtaposes any system of incident waves with its response in the form of diverging waves is the means of describing an entity. Projection and digitization methods are used to algorithmize electrodynamic problems in the simulation of microwave integrated circuits. Simplified models and the elementary interpretation of integrated circuits are discussed in terms of their proper areas of application, merits and disadvantages. Generally speaking, the elementary concepts and heuristic methods used in engineering methods of calculating microwave integrated circuits are inadequate and their use as the basis of mathematical simulation in an automated design system results in the unreliability of the results obtained. The principles of decomposition are discussed in general form, and the method of linear decomposition in which the decomposition diagram representing the structure is in the form of a chain is discussed in particular. The primary electrodynamic problem results in finding the column of a conduction matrix,  $Y$ , or resistance matrix,  $Z$ , and the complete matrix is obtained by solving a series of problems; these problems are called "key" problems. For the formulation of a key problem of a specific type a preliminary determination of the spectrum of natural waves of channels is required and a descriptor is constructed in relation to it in the form of a  $Y$ ,  $Z$  or  $S$  (scattering) matrix. Finding descriptors of isolated independent units is necessary at the first stage in decomposition. The second stage is the recombination stage, which consists in employing a simple rule requiring only algebraic operations. It is algorithmically simpler to find a conduction or resistance matrix than a scattering matrix, so the latter is obtained from the two former. The  $Y$  problem and the analogous  $Z$  problem for general decomposition and the  $S$  problem for linear decomposition are discussed along with the solution of key problems. Other topics discussed in detail include a sudden change in the width of a conductor of a stripline, systems of abrupt changes in width, the transition from a stripline to two coupled lines and combinations with them, the single-mode concept for a length of coupled lines, and a break and combinations with a break. A study is made of the convergence of the method of projection joining used in solving the problem of the end-terminated connection of two waveguide channels. The state of the art and the prospects of diffraction models for microwave integrated circuits are briefly summarized. The results reviewed open the way to further development and implementation of diffraction models for this purpose, but the question of constructing electrodynamic models for elements of microwave integrated circuits containing semiconductor devices remains open. Figures 47; references 45: 35 Russian, 10 Western.

[164-8831]

## MICROSTRIP DIVIDER-ADDERS OF MICROWAVE POWER WITH WIDENED BANDWIDTH

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 26 Mar 80) pp 2059-2063

ZAYENTSEV, V. V. and VINOGRADOV, G. A.

[Abstract] Divider-adders of microwave power based on strip and microstrip lines are widely used in phased antenna arrays, in semiconductor transmitters and in microwave semiconductor switches. With a wide bandwidth, summators are used with several quarter-wave stages as well as on combined transmission lines. It is shown in the present work that in the operating frequency band of such devices, it is necessary simultaneously to assure matching of the inputs (standing wave ratio  $\leq 1.2$ ) and decoupling between the channels (ordinarily not worse than 18-20 dB). The frequency properties are analyzed of nontransforming splitter and short-step transformers. An evaluation is made of losses in various power dividers. Figures 3; tables 2; references: 5 Russian.  
[138-6415]

## CYLINDRICAL DOUBLE-LAYER WAVEGUIDES WITH RESISTIVE FILMS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 1, Jan 82 (manuscript received 17 Nov 80) pp 99-103

RAYEVSKIY, S. B. and BALABANOVA, T. N., Gor'kiy Polytechnic Institute

[Abstract] The characteristics of wave propagation through cylindrical double-layer waveguides with resistive film between layers are calculated on the basis of the general dispersion equation. Calculations are made for two shielded waveguides: one with a circular cross section and concentric layers, one with an elliptical cross section and confocal layers. The third waveguide is an open dielectric one with a circular cross section and a resistive film. Increasing the surface conductivity of the film narrows the frequency range of emerging  $E_{0m}$  and  $EH_{1m}$  waves and decreases the minimum relative phase constant, while making its surface conductivity approach zero extends that frequency almost from zero to cutoff.  
[194-2415]

## DETECTION CHARACTERISTICS OF SEMICONDUCTOR PLATE IN RECTANGULAR MILLIMETER-WAVE WAVEGUIDE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 15 Jul 80) pp 170-172

TOLMACHEV, M. M., TRIFONOV, V. I. and NOVICHKIN, Ye. P.

[Abstract] Generation of a constant transverse emf, together with a longitudinal one, during propagation of a nonuniform electromagnetic millimeter wave in a rectangular waveguide with a semiconductor plate across is analyzed by calculating the field components and taking into account the dispersion relation. The power-voltage characteristic of this transverse effect is also calculated, as a basis for comparison with the longitudinal effect. Figures 2; references 3: 2 Russian, 1 Western.  
[176-2415]

## NATURAL WAVES IN OPEN WAVEGUIDES WITH ROUGH BOUNDARIES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 25, No 1, Jan 82 (manuscript received 25 Nov 80) pp 79-86

CHUK, N. P. and TRET'YAKOV, O. A., Khar'kov State University

[Abstract] Natural waves in the discrete spectrum of a multilayer waveguide medium with statistically rough boundaries are calculated, first for a scalar acoustic field and then for a scalarizable electromagnetic field. The coefficients accounting for the roughness in the differential equation of the boundary-value problem are proportional to the small perturbation parameter  $\sigma^2$ , are functions of the variable wave vector and azimuth angle, and are treated in the Bourret approximation of multiple scattering. The results identify boundary roughness as a principal cause of energy losses and can be useful for the design of open dielectric waveguides for integrated optics. References: 8 Russian.  
[194-2415]

# RESONANCE REFLECTION AND CONVERSION OF SURFACE LIGHT WAVES IN HIGHER ORDERS OF BRAGG DIFFRACTION IN OPTICAL WAVEGUIDES WITH PERIODIC MODULATION OF REFRACTIVE INDEX OF WAVEGUIDE MATERIAL

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 7 May 79, after revision 1 Dec 80) pp 2026-2029

BYKOVSKIY, Yu. A., SMIRNOV, V. L. and SHMAL'KO, A. V.

[Abstract] This work investigates the resonance reflection of surface light waves, and consideration is given to certain properties of their conversion in higher orders of Bragg diffraction in waveguides with periodic modulation of the refractive index of the material of a thin-film waveguide [TFW]. An expression is found for the coupling constant of a periodic TFW for various orders of Bragg diffraction. With the use of the results of two 1978 works from the literature, expressions are presented for the first three orders of diffraction in the case of the TE-mode of a TFW. The total width is found of the spectral characteristics of lattice-type deflection filters lengthwise of the wave  $\lambda$  operating in the higher orders of diffraction. An experimental investigation of the resonant reflection of surface waves in higher orders of diffraction is compared with the results obtained. Figures 1; references 12: 8 Russian, 4 Western (1 in translation). [138-6415]

# THEORETICAL AND EXPERIMENTAL STUDIES OF STRIPLINE DIELECTRIC WAVEGUIDES

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 24, No 12, Dec 81 (manuscript received 24 Mar 81) pp 1522-1529

KARPENKO, V. A., STOLYAROV, Yu. D. and KHOLOMEYEV, V. F., Institute of Physics, Mogilev Division, Belorussian SSR Academy of Sciences

[Abstract] A theoretical study is presented of the electromagnetic properties of a rectangular dielectric waveguide partially inserted into a substrate. The method of partial regions in combination with a single-wave approximation is used to solve the problem in its general formulation. The field in the central region bounded by the narrow ends of the waveguide is represented as one mode of a plane asymmetric waveguide, assuming the lack of the transformation of the incident wave into other types of oscillations in reflection at the side surfaces of the waveguide. The field in the side regions is represented in the form of the general expansion in terms of natural types of waves of a system of two media separated by a plane boundary. The ranges of expansions and the variance equations for the propagation constant which define the field over the entire space are found from conditions for

the approximate matching of fields at the boundaries of the partial regions. The limits of applicability of this approach to solving the problem are established by experimental measurements made in the microwave band. Characteristic equations are found for finding the propagation constant for two types of waves of a stripline waveguide. Numerical calculations are made for waveguides of two types--a rectangular strip on a substrate and a stripline inserted into a substrate. An experiment was conducted in which a rectangular model made of polystyrene with a 1 : 2.5 ratio of its sides was placed on or inserted into, respectively, a substrate made of polytetrafluoroethylene, with the wide end of the model placed parallel to the substrate. This combination was placed into an open resonator bounded at one end by a polished copper mirror with a diameter of 120 mm and at the other end by a reticular reflector by means of which excitation was produced and the presence of resonance was recorded. Studies were conducted in the 6 to 16 mm waveband. Waveguide refractive indexes were computed from the measured resonance frequencies and the number of half-waves. A comparison is made between theoretical and experimental dependences of waveguide refractive indexes on the scaled thickness of principal types of waves of waveguides with various ratios of their sides. The results demonstrate that the single-wave approximation describes with sufficient accuracy the electromagnetic properties of stripline waveguides. Figures 3; references 5: 3 Russian, 2 Western. [164-8831]

UDC 621.372.85

# PROPAGATION OF SURFACE MAGNETOSTATIC WAVES AT ARBITRARY ANGLE TO PARALLEL STATIONARY FIELD

Riev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 9, Sep 81 (manuscript received 7 May 80) pp 56-59

BEREGOV, A. S.

[Abstract] Considerable interest has recently been paid to an investigation of the characteristics of surface magnetostatic waves [MSW], propagating in multilayer ferrite-dielectric structures, which make it possible to create units, analogous to devices based on surface acoustic waves, but operating in the microwave band. As one of the characteristic features of the ensuing devices based on MSW, it is necessary to include the possibility of a considerable rearrangement of the frequency characteristics by an exterior magnetic field. Particular attention has been paid in recent years to problems of creating "nondispersion" delay lines based on MSW. The present work is concerned with a theoretical and experimental investigation of the properties of a MSW, propagating in a metal-dielectric-ferrite structure which consists of three layers: dielectric, ferromagnetic and dielectric. It is shown that one of the principal advantages of delay lines based on surface acoustic waves--their rearrangeability, with maintenance of the principal characteristics--can be realized in a three-layer metallized ferrite-dielectric structure with a change of the vector of the magnetizing field. Figures 3; references 5: 1 Russian, 4 Western. [91-A-6415]



## COMPARATIVE ESTIMATE OF DIMENSIONS OF MICROWAVE DEVICES BASED ON SOLID-STATE RESONATORS

Moscow RADIOTEKHNIKA in Russian Vol 37, No 1, Jan 82  
(manuscript received after completion 6 Jul 81) pp 63-66

GOLOLOBOV, V. P., TUREYEVA, O. V., TSYMBAL, V. I. and SHELAMOV, G. N.

[Abstract] Gyromagnetic and dielectric solid-state resonators are being used in modern microwave equipment for purposes of miniaturization. Although the electrical characteristics of non-retunable microwave devices based on resonators of these types may differ but slightly, their weight and dimensions differ considerably both in absolute terms and relative to their dependence on frequency. A comparative analysis of the dimension relationships of dielectric and gyromagnetic resonators is presented here. The dimensions of dielectric resonators depend on the operating frequency of devices in which they are used and on the dielectric constant of the resonator's material. Curves are shown, illustrating the dependence on frequency of the minimum size of 2-resonator and 4-resonator microstrip microwave devices based on dielectric resonators. The length of waveguide microwave devices depends on the number and sizes of dielectric resonators used. A gyromagnetic resonator per se is the most miniature microwave resonator and its resonance frequency does not depend on its dimensions but is determined by its shape and the magnitude of the magnetic field. An analysis is made of variants of the magnetic systems of non-retunable microwave devices based on gyromagnetic resonators and of magnetically retunable microwave devices. It is demonstrated that the size and weight of microwave devices based on gyromagnetic resonators increase with an increase in the upper frequency of the operating band. Up to frequencies of 3 to 5 GHz, microwave devices based on gyromagnetic resonators have smaller overall dimensions than those based on dielectric resonators. This represents an added advantage to the fact that gyromagnetic resonators are simple to tune with respect to frequency. Figures 5; references 12: 11 Russian, 1 Western.  
[165-8831]

UDC 621.372.832

METHODS USING STRIPLINES FOR EFFICIENCY INCREASE OF POWER ADDITION--  
DIVISION MULTICHANNEL SYSTEMS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81  
(manuscript received 24 Mar 80, after completion 24 Nov 80) pp 42-47

ZAYENTSEV, V. V.

[Abstract] Use of multichannel systems for addition of the power of a large number of microwave generators in an overall load makes it possible to

increase the useful load by 2-3 orders of magnitude, as compared with the power of an individual semiconductor device. An important electrical parameter is the overall efficiency of a circuit for additions of powers, taking into consideration the energy effectiveness of an addition-division system. Losses in the microstrip lines of the lower part of the microwave band (to 1-2 GHz) are primarily determined by the dissipation losses in the stripline conductors. In the dielectric, losses are 30-40 times less. It is also possible to neglect losses by radiation and excitation of higher types of waves in the long-wave part of the microwave band. Consequently, the problem of increasing the efficiency of a system for addition of powers of the longwave part of the microwave band, where sections of the transmission lines have a considerable electrical length, is connected first of all with a decrease of dissipative losses in stripline conductors. The present work formulates the principal means of increasing the efficiency of stripline power summatoms. Realization of a means for development of a decrease of losses in microstrip summatoms gives a significant gain of efficiency in the lower part of the microwave band during addition of the powers of a large number of signal sources ( $10^2$ - $10^3$ ). In addition, the limiting level of power which it is possible to transmit through the basic element of a summatom, in connection with a decrease of the wave impedance of lines, is increased. For experimental verification of the principal positions, two types of microstrip 4-channel power summatoms were developed and investigated on standard transmission lines with a ladder network with an external quarter-wave transformer. Each summatom is arranged on two standard dielectric substrates with a dimension of  $48 \times 60 \text{ mm}^2$ . Losses were measured by standard equipment with an opposing connection of two identical basic units in a division-addition regime with subsequent conversion of losses for one element. Losses in the basic elements do not exceed 0.13 dB in an operating frequency band. Figures 4; tables 2; references: 7 Russian. [91-A-6415]

UDC 621.372.832:621.382

#### ELECTRICALLY CONTROLLED DIRECTIONAL COUPLER WITH CASCADED COUPLING ZONE

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 6 Feb 80) pp 2211-2213

USOV, N. Yu.

[Abstract] This brief communication investigates the characteristics of an electrically controllable directional coupler with 6 loop coupling elements incorporated in the E-planes of rectangular waveguides. The experiments were conducted in the 2-centimeter range (12-16 GHz) with the cross sections of the couple waveguides  $8 \times 17 \text{ mm}^2$ . The procedures and the units used are described. Figures 2. [138-6415]

## PROCEDURE FOR CALCULATION OF PARAMETERS OF BROAD-BAND ATTENUATOR FOR MICROWAVE MICROCIRCUITS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 9, Sep 81 (manuscript received 29 Jan 80, after revision 25 Nov 80)  
pp 75-77

POLYANSKIY, A. M., ZAVERTAN, S. I. and RASPOPIN, V. N.

[Abstract] A procedure for calculation of attenuators is considered in four works from the literature (1969 [2], 1970, 1971). However, the calculated relationships proposed by the authors of these works are fairly complex, and a solution with a precision satisfactory for engineering practice can only be obtained by the use of a digital computer, and an analysis of design from the point of view of optimizing its characteristics and dimensions is difficult. During consideration of a procedure for calculating the parameters of broadband attenuators for microwave microcircuits, the present brief communication uses the following characteristics: width of inlet line  $\tau$ , width and length of the resistive bands  $L'$  and  $L$ , respectively, resistance of the square of the resistive band  $R_s$  and the specified magnitude of attenuation  $A$ , dB. The results of calculations on a digital computer are presented for various ratios  $L'/L$  (from 1 to 10) and  $\tau/L'$  (from 0.1 to 0.5). All the results obtained are also valid for the design described in a 1969 report by Yu. A. Goryachev. It is necessary only to introduce certain symbols. For verification of the calculated data, test specimens of the attenuators were prepared, in which nonsymmetric microstrip 50-ohm lines were used as the input and output contacts. Units with an attenuation from 3 to 20 dB were prepared on 22 KhS substrates, and deposition of resistive and conducting films was accomplished by the vacuum-thermal method using standard technology. In the frequency band from 0 to 7 GHz, experimental and calculated values of the attenuators differed in the limits of measurement errors. The change in the frequency band did not exceed  $\pm 10\%$ , and the voltage standing wave ratio in the 0.5-7 GHz range in the limits 1.1-1.35. Figures 3; references 7: 6 Russian, 1 Western in translation.  
[91-A-6415]

UDC 621.396.67

## RADIATION FROM POINT CHARGE MOVING UNIFORMLY ALONG AXIS OF NARROW CYLINDRICAL RING

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 25, No 1, Jan 82 (manuscript received 4 May 81) pp 87-92

PAZYNIN, L. A. and SOLOGUB, V. G., Institute of Radiophysics and Electronics, UssR Academy of Sciences

[Abstract] The radiation field of a point charge moving at constant velocity along the axis of an ideally conducting waveguide with circular cross section

is represented as the sum of its intrinsic field in free space and the field due to scattering by a cylindrical shield. Calculations are based on the approximation of a given surface current. The corresponding Fredholm integral equation of the second kind is solved by the method of successive approximations. The solution is found to be asymptotically exact for a waveguide segment in the form of a narrow ring, i.e., a segment much shorter than its diameter. Figures 1; references 8: 7 Russian, 1 Western.

[194-2415]

## POWER ENGINEERING

UDC 621.31.027.89

### ULTRAHIGH-VOLTAGE ELECTRICAL EQUIPMENT COMPLEXES

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 82  
(manuscript received 6 Oct 81) pp 2-6

BORTNIK, I. M., doctor of technical sciences, KULAKOV, V. P., engineer,  
and SOKOLOV, N. N., engineer

[Abstract] Data are presented on performance and cost of ultrahigh-voltage electrical equipment, according to projections by the USSR State Planning Committee for 1981-85 and 1985-90 five-year periods, for energy transmission over 2500-3500 km distances to the Central region from proposed state regional atomic electric power plants using Ekibastuzk or Kansk-Achinsk coal as well as to the Ural region from Ekibastuzkaya and Surgutskaya state regional electric power plants using coal and natural gas respectively. The equipment complexes scheduled for production by the electrical engineering industry includes 750 kV a.c. equipment (since 1972), 1150 kV a.c. equipment (since 1981), d.c. equipment for 12-phase 355 MW power unit (since 1979) and equipment for 12-phase 1500 MW power unit. Items of particular interest are internal insulation of transformers, reactors, dischargers, thyristors and other equipment in converter substations. Some rough estimates have been also made pertaining to 1500 kV and 1800-2000 kV equipment in projections for the 1990-2000 decade. Tables 2; references: 3 Russian.  
[175-2415]

UDC 621.314.21

### EQUIVALENT TIME CONSTANT OF POWER TRANSFORMER FOR CALCULATION OF SHORT-CIRCUIT CURRENT

Novocherkassk IZVESTIYA VUSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROTEKHNIKA  
in Russian No 11, Nov 81 (manuscript received 7 Apr 81) pp 1189-1192

ZASYPKIN, ALEKSANDR SERGEYEVICH, candidate of technical sciences, docent,  
Novocherkassk Polytechnical Institute

[Abstract] It is shown that during determination of the equivalent time constant of an aperiodic component of a short-circuit current, in order to

analyze the behavior of relay protection it is necessary to use the electric resistance of the winding of a transformer and not the active component of the short-circuit impedance, which is determined by the total losses of the short circuit, as is customary at present. Figures 2; references: 4 Russian. [92-6415]

UDC 621.314.214.332.072.2:621.311.001.41

SOME RESULTS WITH QUADRATURE VOLTAGE REGULATION DEVELOPED FOR AND  
INTRODUCED IN 750-330 kV NETWORKS

Moscow ELEKTRICHESTVO in Russian No 2, Feb 82 (manuscript received 11 Jun 81)  
pp 47-49

YERSHEVICH, V. V., candidate of technical sciences, KRAYZ, A. G., candidate of technical sciences, and KRIVUSHKIN, L. F., candidate of technical sciences

[Abstract] Special QVR transformers for quadrature regulation of voltage at 750/330 kV autotransformers were designed in order to improve the operation of 330 and 750 kV networks in the Ukraine by making it more economical and at the same time facilitating control of power transfer as well as overloads on individual network segments. The gist of this method of regulation is connecting such a transformer, with a rating up to 210 MVA, into the neutral line of a 750/330 kV autotransformer so as to produce a phase shift of up to  $12^\circ$  on both sides and thus change the power transfer by 250-400 MW. These transformers were developed by the MPO (Intergovernmental Organization) "Elektrozavod" imeni V. V. Kuybyshev in 1974 and then installed in three substations of the Southern integrated power system beginning in 1977. These substations, selected on the basis of system analysis, are: Donbasskaya (500 MW), Dneprovskaya (400 MW) and Vinnitskaya (450 MW), each with four groups of 3-phase transformers (12-phase system). Experience so far has shown that these transformers do not as yet perform according to expectations. Studies are underway to correct their design and location in a given substation. Studies are also underway to extend the application of this method of regulation to other components of a power system, particularly atomic electric power plants, and to other integrated power networks such as the Northwestern one including Leningrad during the 1985-90 period. Figures 3; references: 3 Russian. [197-2415]



## THERMOSETTING INSULATION FOR HIGH-VOLTAGE TOROIDAL TRANSFORMERS

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 82  
(manuscript received 19 Mar 81) pp 54-56

SILANT'YEV, V. A., engineer, TRUBACHEV, S. G. and TALYKOV, V. A., candidates of technical sciences, and YAROSHENYA, Ye. I., engineer

[Abstract] The results are given of studies of features of the hardening process of thermosetting insulation materials used for high-voltage toroidal transformers of the IOT type, for the purpose of optimizing temperature and time conditions of this process and comparing the key electrical characteristics of the hardened insulation over a wide temperature and voltage range. IOT transformers are designed for powering incandescent lamps used for lighting landing strips and taxiways at airfields. The transformers are sealed in a rubber case after the insulation is applied and they are placed directly in the ground. Various kinds of mica-containing tape are used for the insulation, including the mica-and-fiberglass-impregnated LSEP-934-TP and LSK-110-TP brands using a polyester epoxy binder and the LSEN-526u brand, using an epoxy novolac resin binder. The latter two types have improved the mechanical characteristics of transformer insulation and its heat resistance. Hardening of the binder in tapes of different types was studied in samples of tape and the hardening process was observed in terms of the change in conductivity and the loss tangent in the process of a uniform rise in temperature at the rate of 1.5 to 2 °C per minute from 20 to 180 to 200 °C with subsequent cooling of the hardened samples. Measurements were made with an EPPV-60 potentiometer and an R-589 bridge. The data show that the process of hardening of the binder begins to occur most intensely at 130 to 140 °C in LSEN-526U and LSK-110-TP tape and at 150 °C in LSEP-934-TP tape. The binder hardening process is concluded in 2 to 3 h for LSK-110-TP tape and in 3 to 4 h in LSEN-526u tape at a temperature of 150 °C, directly on IOT-type transformers. Full-scale longterm tests were made on IOT transformers at 12 kV, corresponding to an electric strength of 5 kV/mm, with a determination of the change in the loss tangent, the intensity of partial discharges and other parameters of the insulation in the process of electrical aging and an estimate was made of the service life and safe life of the insulation. The results demonstrate that insulation based on LSEN-526u tape has considerably better insulation properties than that based on LSEP-934-TP tape. Studies were made of the water resistance of transformer insulation by removing the rubber case and immersing the transformers in water at room temperature so that their terminals were above the surface of the water. Under these conditions the insulation's resistance went from  $8 \cdot 10^{11} \Omega$  in the original state to  $1.5 \cdot 10^{11} \Omega$  after 3 24-h periods for LSEP-934-TP tape. Insulation based on LSEP-934-TP tape has a safe life of 10,000 h at the operating electric strength of 5 kV/mm. Replacing this tape with LSK-110-TP and LSEN-526u tape increases the reliability of transformer windings with a simultaneous improvement in service life and heat resistance of the insulation. Figures 7; tables 2.

[167-8831]

## LIGHTNING PROTECTION CHARACTERISTICS OF SUPERHIGH-VOLTAGE POWER TRANSMISSION LINES WITH GROUND WIRES

Moscow ELEKTRICHESTVO in Russian No 3, Mar 82  
(manuscript received 8 Feb 79) pp 66-69

MAYKOPAR, A. S. (deceased), candidate of technical sciences, Moscow

[Abstract] The problem of the lightning safety of high-voltage power transmission lines with ground wires is based on the unity of the primary factors and physical picture of the effect of lightning for high-voltage power transmission lines with lower voltage lines for which there are experimental data available on operational and theoretical studies including a broad range of problems. An analysis of the lightning resistance of such lines served as a basis in the development of a method which, with determination of values of the equivalent wave impedance of the lightning, allows calculation of the lightning resistance of 110-500 kV lines with ground wires. The corresponding data for lines of various designs are presented in tabular form. The calculated number of lightning disconnects of 110-500 kV lines with ground wires differs from the operational data actually experienced by 35%. For 750-1800 kV lines with ground wires when lightning strikes the towers the number of lightning disconnects is very small if the peak resistance of the tower support is low, basically a result of the great peak resistance of the insulation. An important factor in determining the probability of breakthrough of lightning to the conductors is the height of orientation of the lightning, determined by the extrapolation of the discharge voltages, leading to a significant variation in the danger of breakthrough as a function of the protective level of the line. The probability of lightning breakthrough is decreased by a factor of more than 5 for 750-1800 kV lines. Figures 5; tables 2; references 14: 8 Russian, 6 Western.  
[196-6508]

UDC 621.315.2-713

## CALCULATION OF CURRENT-CARRYING CAPACITY OF FORCED COOLED HIGH-VOLTAGE CABLE LINES

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 82  
(manuscript received 10 Apr 81) pp 56-58

KARCHEMSKIY, F. S., TSEYTLIN, M. S. and KAMINSKIY, M. L., engineers

[Abstract] The current-carrying capacity of oil-filled cables is increased by forced cooling, which is accomplished by three methods: direct, surface and internal, depending on the relative positions of the cable and the cooling agent. The surface and indirect methods are the simplest and are sufficiently

effective methods of cooling and make it possible to improve the current-carrying capacity of cables already mastered by the USSR's industry. In the first case the heat is removed directly from the surface of the cable and in the second through a layer of filler material placed between the cable and conduit carrying the cooling agent. A calculation method is suggested for the proper determination of the permissible load on lines of these sorts. It is assumed that the heat field in any cross section of a system consisting of loaded cables and cooling system conduits can be regarded as the result of the superposition of two fields: the field of the heat sources, i.e., the conductors and sheaths of the cables, which remains constant over the length of the line, and the field of the cooling agent, which varies along the length of the line only with a change in the temperature of the cooling agent. A procedure is presented whereby equations are derived which make it possible to calculate the temperature of elements of the system and by means of an iteration calculation a determination is made of the total heat flow from the cable with which the temperature of the conductor along the line does not exceed the permissible value. The permissible current is calculated once the total heat flow from the cable and the temperature of all elements of the system are known. Programs have been developed in keeping with the procedure described and a calculation has been made on a "Mir-2" computer of the current-carrying capacity of 110-kV oil-filled cables for a number of standard cross sections. Data are presented on the effectiveness of the kinds of forced cooling considered as compared with natural cooling. For MNAgShVu cable with a cross section of 800 mm<sup>2</sup> the permissible load current with indirect cooling with a system of three conduits equals 888 A and 1013 A under specific conditions, corresponding to a 71- and 89-percent increase in permissible load current as compared with that of 520 A with natural cooling. The permissible load current values for an indirect cooling system with a single conduit equal 857 and 981 A and 1462 A for a surface cooling system. Figures 1; tables 3; references: 3 Western.

[167-8831]

UDC 621.372.632

#### REQUIREMENTS ON TRANSFORMERS AND APPARATUS FOR EXTREMELY HIGH VOLTAGE

Novocherkassk IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: ELEKTROMEKHANIKA  
in Russian No 11, Nov 81 (manuscript received 16 Apr 81) pp 1185-1188

KHODZHAYEV, MAMED NISREDINOVICH, candidate of technical sciences, chief of division, VGPI [? All-Union State Design Institute] and NII "Energosetproyekt" [All-Union State Planning, Surveying and Scientific Research Institute of Power Systems and Electric Networks], Moscow

[Abstract] The present work discusses requirements for basic equipment with a voltage of 500 kV and above. In accordance with decisions of the 26th CPSU Congress it is planned to continue work on further extension of the

Unified Power System [UPS] of the country. For this purpose and for transmission of the power of electrical stations which use coal of the Ekibastuz and Kansk-Achinsk basins, as well as natural and byproduct gas of the beds of Western Siberia, in the 11th Five-Year Plan it is planned to create system-forming networks with AC voltages of 1150, 750 and 500 kV and construction of electrical transmission of the Ekibastuz-Center 1500 kV DC. As an immediate prospect, connection of the joint power system of Central Asia to the UPS of the USSR will be accomplished, and later the joint power system of the Far East will enter into the structure of the USSR UPS. The principal direction of development of transformer construction in the forthcoming period must be a farther increase of the unit power of transformers and the mastering of new transformers for higher classes of voltage. In the 11th Five-Year Plan for the electrical transmission (which is planned and under construction) for distribution of the power of the Ekibastuz and Sugrutskiy State Regional Electric Power Station, series production must be mastered of single-phase transformers and autotransformers with a 1150 kV power of 417 and 667 megavolt ampere, respectively. For complete realization of the transmission capacity of electric power transmission lines for 1150 kV, in the next 10-15 years transformers are required with a transfer power of 5-6 thousand MVA in a group or 1.6-2 thousand MVA in phase. In electrical equipment for extremely high voltage the requirements for measuring transformers substantially increase. The basic technical requirements for circuit breakers are determined at the Institute "Energoset'proyekt" [see above] together with the institutes "Teploelektroproyekt" [All-Union Order of Lenin Institute for the Planning of Electrical Equipment for Heat Engineering Structures] and "Gidroproyekt" [All-Union Planning, Surveying and Scientific Research Institute imeni S. Ya. Zhuk]. In the USSR at present all the necessary conditions have been put together for wide build-up of the production of elegaz (sulfurhexafluoride) switching equipment. The necessity of creating elegaz equipment at a voltage of 500-1150 kV is determined by the fact that the equipment is a new stage in the development of technology which makes it possible to reduce the area which is occupied by the distribution device, and to increase the reliability of the power supply and the reliability of operation. A complex device of 1150 kV fulfilled on the basis of elegaz insulation, not only makes it possible to reduce the area occupied by several times, but also gives the possibility of reducing by almost two times the material expenditure, and to eliminate the ecological effect of the extremely high voltage and to accelerate the data of introduction of substations.

[92-6415]

## ELECTRONIC HIGH-VOLTAGE SWITCH 'DLYa' FOR HIGH-SPEED PROTECTION

Moscow ELEKTROTEKHNIKA in Russian No 2, Feb 82  
(manuscript received 7 Jul 81) pp 24-26

PEREVODCHIKOV, V. I., doctor of technical sciences, LIPATOV, V. S.,  
candidate of technical sciences, MATVEYEV, N. V., engineer, and GUBIN, L. A.,  
engineer

[Abstract] An electronic high-voltage switch has been developed and tested as high-speed device for protection of power supplies operating under loads which break down frequently, typically for use with ion injectors in thermonuclear plants. It is based on an ELV 20/70 electron-beam diode for continuous or pulse duty, with automatic reclosing (100 microsecond - 20 ms). Its peak rating is 70 kV - 20 A, maximum repetition rate in the pulse mode 10 kHz. Its static plate characteristics (plate and control currents as functions of plate voltage at control voltages from 2 to 8 kV) and control characteristics (control voltage and power as functions of plate current) were measured, its transient response at various ratios of plate voltage to control voltage was recorded on an oscillograph. The performance characteristics of this device are switch-off time 1 microsecond maximum, switch-on time 5 microsecond maximum, and efficiency 96%. Appurtenances include a power supply to cover intrinsic losses in the switch, isolating power and signal transformers, and control circuit with programmer. Figures 6; references: 5 Russian.  
[175-2415]

## DETERMINATION OF AXISYMMETRIC DEFORMATION TEMPERATURE OF LARGE PARABOLIC MIRRORS

Ashkhabad IZVESTIYA AKADEMII NAUK TURKMENSKOY SSR: SERIYA FIZIKO-  
TEKHNIЧЕСКИХ, ХИМИЧЕСКИХ И ГЕОЛОГИЧЕСКИХ НАУК in Russian No 6,  
Nov-Dec 81 (manuscript received 20 Mar 80) pp 47-54

MACHUYEV, Yu. I., SOLODOVNIKOVA, L. A., SOKOLOV, Ye. V., NAZAROV, A. N.  
and FOKIN, V. G., "Solntse" Scientific Production Association, TuSSR Academy  
of Sciences

[Abstract] Mildly sloping envelopes of various types are widely used at present. This includes dome-shaped designs of structural building, concentration of solar energy, and the parabolic and hyperboloid bowls for the antennas of radiotelescopes. As a rule all these constructions are found in the open air and are subjected to a complex of climatic influences, among them solar radiation. Heating of the envelopes leads to their temperature



deformation, to a variation of the surface from the initial state. Such a variation of the surface, unimportant for structural building, must be taken into account in the operation of solar power plants and radiotelescopes. It is shown that in order to assure minimum distortions of the average surface of paraboloid mirrors in the case of temperature distortions, the parameter of the slope of the envelope  $\chi$  must exceed the magnitude 0.05-0.06. Accordingly it is necessary to select the form of a paraboloid mirror surface. Figures 2; tables 2; references: 3 Russian.  
[90-6415]



UDC 535.241.13

ACOUSTOOPTICAL GALLIUM PHOSPHIDE DEFLECTOR

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 23 May 80) pp 2233-2234

AZAMATOV, Z. T., VOLOSHINOV, V. B., MAMATDZHANOV, F. D. and  
PARYGIN, V. N.

[Abstract] In the present brief communication a cubic crystal of gallium phosphide is used as a means for interaction of light and sound. Diffraction of light is accomplished with the use of shear acoustic waves propagating along one of the axes of the crystal. The acoustooptical quality of the material for the acoustic mode chosen equals  $M = 24.1 \cdot 10^{-18} \text{ c}^3/\text{g}$ . The cells of the deflectors are  $0.65 \times 1.5 \times 1.5 \text{ cm}^3 \text{ GaP}$  crystals cut along the crystallographic axis with piezoelectric transducers. Plates of X-cut  $\text{LiNbO}_3$  with dimensions  $l = 0.8 \text{ cm}$ ,  $d = 0.4$  serve as the piezoelectric transducers attached to the acoustic line. Four acoustooptical cells are used in the investigation. The scheme of the model of an acoustic optical cell and the frequency characteristics of diffracted light are presented. In the acoustooptical cells investigated the maximum resolution of  $N$  proved to be equal to 160-180 elements. The speed of response of the deflectors is characterized by the time  $\tau = 3.7$  microsecond. The efficiency of diffraction with a controlling electrical power of 1 W amounted to 16-25%. Figures 1; references: 3 Russian.  
[138-6415]

UDC 537.874.8

SIMULATION OF RADIOHOLOGRAPHY PROCESS BASED ON METHOD OF EDGE WAVES

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 15 Nov 79, after revision 23 Dec 80) pp 2030-2033

PASMUROV, A. Ya.

[Abstract] In order to solve the problem of diffraction of electromagnetic waves in a high-frequency approximation, a diagram of the effective surface

scattering [ESS] of the individual "shining" points of the object is necessary. Such characteristics of scattering, named the localized, can be obtained analytically or experimentally. Determination of the localized characteristics of scattering of bodies of complex form is possible as a rule by experimental means. The method of radioholography is used for this, in particular the method of converted synthesization of complex one-dimensional Fourier radioholograms because of rotation of an object around its center of mass. Up to now, for analysis of this method, a hypothetical body was used which consisted of a totality of isotrope point reflectors. In the present work an ideally conducting cylinder of finite dimensions is chosen as the scatterer. It is shown that Fourier radioholography makes it possible to determine the local characteristics of scattering of bodies with a potential precision of the order of 0.5 dB, possible by means of the use of apodization at the stage of restoration of the object's image. An algorithm of digital simulation of the radioholographic process is developed which makes it possible to verify the efficiency of the measuring unit and to evaluate the equipment error of measurement. The proposed algorithm can be used as a test for solution of such problems, as a determination of the permissible degree of the effect of various distorting factors on the precision of measurement of the localized characteristics of scattering; choice of the optimum parameters of recording of radioholograms; investigation of various methods of digital processing of radioholograms, conducted with the object of correction and elimination of distortions; increase of the signal-to-noise ratio; accomplishment of spatial filtration, etc. The author is grateful to P. Ya. Ufimtsev for attention to the work. Figures 3; references 5: 4 Russian, 1 Western.

[138-6415]

UDC 538.61

# DIFFRACTION OF LIGHT BY MAGNETIC BUBBLE LATTICES IN FERRITE GARNET CRYSTALS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 24, No 12, Dec 81 (manuscript received 10 Feb 81) pp 1536-1540

MOROZOV, A. M. and SEMENTSOV, D. I., Severo-Osetinsk State University

[Abstract] The results are given of an experimental study of the spatial and polarization structure of laser radiation diffracted by means of a hexagonal magnetic bubble lattice in an epitaxial film with the approximate composition  $Y_2BiFe_{3.8}Ga_{1.2}O_{12}$ . The results are compared with theoretical results obtained by the authors in earlier studies (1978, 1979), and the magneto-optical nature of diffraction in magnetic bubbles is taken into account. The saturation magnetization was 160 Gs, the uniaxial anisotropy field  $10^3$  Oe, the thickness of the film 8.4  $\mu$ , the mean diameter of equilibrium magnetic bubbles with  $H_{\text{perp}} = 0$  was approximately 8  $\mu$ , specific Faraday rotation was  $1.8 \cdot 10^4$  deg/cm and the absorption coefficient was  $770 \text{ cm}^{-1}$  at a wavelength of 0.63  $\mu$ . The quality parameter for the sample

studies was greater than 1, testifying to the stability of the magnetic bubble structure in it. The magnetic bubble structure and the individual diffraction spectra were observed by means of a polarizing microscope and this confirmed the essential dependence of their parameters on the magnitude of the external magnetic field, and the nature of the diffraction spectrum was distinctly dependent on the ratio between the lattice parameter and the diameter of the bubble,  $a/d$ . Photographs are shown, illustrating the change in the diffraction spectrum with reordering of a magnetic bubble lattice with three values of the magnetic displacement field-- -40, 0 and 65 Oe. An increase in the displacement field is accompanied by a successive change in the intensity of the diffraction maxima right up to the complete disappearance of some of them and the redistribution of intensity between them. The dependence of the diffraction spectrum on the displacement field is in good agreement with the results of the studies mentioned above. Curves, plotted from the theoretical data, are shown, illustrating the dependence of the intensity of various diffraction maxima on the parameter  $a/d$ . It is demonstrated that a change in the distribution of magnetization in the domain structure under the effect of the displacement field results in a change in the state of polarization of the light field. Whereas the polarization of light at higher orders of diffraction for the case of a binary distribution of magnetization does not depend on the magnitude of the displacement field, i.e., on  $a/d$ , at the zero maximum with  $H_{\text{perp}} < 0$  the polarization becomes different from the polarization of the incident radiation. The angle of rotation of the polarization plane can be both positive and negative depending on whether  $a/d$  is greater than or less than  $(\pi/\sqrt{3})^{1/2}$  with a given value of the displacement field. With an increase in  $H_{\text{perp}}$ , regardless of its sign, both the intensity of the zero maximum and the absolute value of the angle of rotation of the polarization plane increase. With a magnetic displacement field value equal to the field for bubble collapse, the diffraction pattern disappears and rotation of the polarization plane suddenly reaches the angle of Faraday rotation of the saturated sample. The influence of the geometry of the magnetic bubble lattice on the distribution of intensity of the light field in different orders of the diffraction spectrum can be observed on the screen of an oscillograph with the effect of an alternating magnetic field on the lattice. Figures 5; references 7: 5 Russian, 2 Western. [164-8831]

UDC 621.37/39.534

#### WIDEBAND ACOUSTO-OPTICAL DEFLECTORS WITH MULTIELEMENT TRANSDUCERS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 22 Feb 80) pp 182-184

DERYUGIN, I. A., POGIBEL'SKIY, A. P., TALALAYEV, M. A. and TETERIN, G. E.

[Abstract] A wideband light deflector for acousto-optical scanners is described which features control of light diffraction by an acoustic wave.

Such an ultrasonic wave is produced by a multielement grating with steps

$H = \frac{vm}{2f_0}$  high ( $v$ - acoustic velocity in the acousto-optic material,  $f_0$ - acoustic

frequency at which the Bragg condition is satisfied precisely,  $m$ - integer). Adjacent segments of the acousto-optic transducer must be excited in phase when  $m$  is even and in phase opposition when  $m$  is odd. The optimum value of parameter  $A = \pi \lambda_0 f_0^2 L / 2nv^2 \cos \theta$  ( $\lambda_0$ - wavelength of light in vacuum,  $n$ - refractive index of acousto-optic material,  $\theta_0$ - angle of light incidence,  $L$ - length of grating segment) is  $0.5\pi$ , the diffraction efficiency not dropping below 0.9 over a frequency range at least as wide as  $(0.7-1.2)f_0$  with a sufficiently low degree of segmentation. With such multielement transducers it is possible to widen the scan angle without decreasing the transducer dimension in the direction of light propagation to a point where the Bragg condition will be violated and the acoustic power density with attendant temperature gradients will become excessive. Figures 3; references 4: 2 Russian, 2 Western. [176-2415]

UDC 621.372.8

#### CYCLOTRON RESONANCE MASER RESONATORS WITH SPECIFIC LONGITUDINAL DISTRIBUTION OF HIGH-FREQUENCY FIELD

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian Vol 24, No 12, Dec 81

(manuscript received 19 Jun 80, after revision 23 Apr 81) pp 1530-1535

MALYGIN, S. A., Institute of Applied Physics, USSR Academy of Sciences

[Abstract] A previous study (1969) described the traditional method of determining the natural frequencies and longitudinal distribution function,  $f(z)$ , of the high-frequency field for the specific profile of an open resonator formed by means of sections of round slightly irregular waveguides, without taking resistance losses into account, and the basic principles of synthesizing resonators with a given field distribution were presented. Here a description is given of a variant of the synthesis method in which  $f(z)$  is selected on the basis of the required properties of the device in the regular region of the resonator and the shape of the remaining section of the resonator is specified by a piecewise linear function. Forced oscillations are considered in a resonator bounded on the left by a semiinfinite supercritical waveguide when a wave strikes from the right. An equation is given for the longitudinal distribution of the field in the resonator and the radius of the regular portion of the resonator is calculated. The synthesis procedure has two steps: 1) A starting profile is selected which contains a regular waveguide of specific radius with a supercritical constriction at its left end; 2) an output circuit with a specific configuration is attached to the starting profile. The position of the joining plane,  $z_s$ , must be selected to ensure a maximum for function  $G(\omega_0, z_s)$ , where  $G$  is a factor proportional to the ratio of the energy stored in the resonator to the

incident power and  $\omega_0$  is the resonance frequency. Possible profiles of resonators with different field distributions are presented. Final synthesis is achieved by varying the configuration of the output circuit and analyzing the resonators produced by a numerical solution to the equation describing the longitudinal distribution of the field in the resonator with the boundary conditions for the radiation. Examples are given which illustrate application of the method to synthesizing structures with a specific distribution of the high-frequency field. It is shown that it is feasible to use some of the structures discussed as resonators for cyclotron resonance masers with the enhanced discrimination of parasitic oscillations. The same resonators make it possible to achieve fairly high efficiency for cyclotron resonance masers. The author thanks S. N. Vlasov and Sh. Ye. Tsimring for helpful discussion and interest in the work. Figures 3; references: 7 Russian. [164-8831]

UDC 621.373.826:621.376

# LOSSES BY TRANSFORMATION OF GAUSSIAN BEAM IN QUASI-OPTICAL DIRECTIONAL COUPLER

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian Vol 24, No 9, Sep 81 (manuscript received 21 Jul 80) pp 20-25

LEBEDYUK, I. I. and SHEVCHENKO, Yu. D.

[Abstract] Quasi-optical directional couplers (QODC) are of interest in the creation of a wide class of devices which includes dividers and adders. The QODC is a plane or plane-laminated periodic or homogeneous structure arranged at an angle of  $45^\circ$  to a plane wire grating, in the direction of propagation in an optical waveguide. One of the most important requirements placed on it is low losses at transformation. The present work describes experimental investigations conducted on a model of a multichannel quasi-optical adder in a lens optical waveguide, using coated lens of polystyrene as phase collectors, and as excitation devices a two-made conic transition, which gave a good coincidence with theoretical evaluations. It is shown that:

1) Frequency periodic wire structures are preferable from the point of view of a decrease of the losses at transformation in the QODC; 2) Losses at transformation of a Gaussian beam light waveguide are basically determined by a change of the path of movement of the "center of gravity" of the transmitted and reflected waves during diffraction at the structure of the QODC and to a smaller degree by a change of the dimensions and radius of curvature of the phase front of diffractor beams; 3) Calculated values, averaged according to the number of channels, of losses at a transformation of the operating wave of a light waveguide into waves of higher types for 6-channel dividers (adders) with network connection of QODC according to circuits depicted in Figures 1-a, b of the present work, without taking account of losses in the phase correctors, amount to 0.8 and 0.2 dB, respectively, with the value of the radius  $r_0$  of the wires which satisfy the relationship  $Kr_0 = 0.361$ ; 4) The creation is possible of a multichannel quasi-optical



adder or divider which have small losses at the transformation of the operating wave of a light waveguide into waves of higher type. Figures 5; references 6: 4 Russian, 2 Western (1 in translation).  
[91-A-6415]

UDC 621.378.33

EFFECT OF NATURAL OSCILLATIONS IN A DISCHARGE ON CHARACTERISTICS OF  
WAVEGUIDE CO<sub>2</sub> LASERS

Gor'kiy IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOFIZIKA in Russian  
Vol 24, No 11, Nov 81 (manuscript received 25 Dec 80) pp 1408-1410

KORNILOV, S. T., PROTSENKO, Ye. D., CHIRIKOV, S. N., Moscow Engineering and  
Physical Institute

[Abstract] Natural oscillations in gas discharges are one of the sources of fluctuations of the power of gas-discharge lasers and, in particular, lasers based on carbon dioxide. The results of investigations of the properties of plasma CO<sub>2</sub>-lasers of low pressure are presented in a number of works from the literature. However, only one communication concerning observation of the relaxation stage of the reactive oscillations of discharge of a waveguide CO<sub>2</sub>-laser is known. The typical generation regime of waveguide lasers (high pressure of operating mixture, increased density of discharge current) and the prospects for their practical application brings about interest in an experimental investigation of the natural oscillations in the discharge of waveguide lasers. The present brief communication is concerned with a study of such oscillations and their effect on the characteristics of CO<sub>2</sub> lasers. The natural oscillations in the discharger of nonflow-type waveguide CO<sub>2</sub> lasers with various magnitudes of the waveguide cross section were investigated. The waveguides were prepared by gluing together four polished plates of beryllium oxide. The magnitude of the cross section of the waveguide of one of the lasers equalled 1.5 x 1.5 mm<sup>2</sup> and of a second 1.5 x 1.0 mm<sup>2</sup>. The length of each of the discharge gaps, components of the active element of the laser, was equal to 61 mm. Filling of the lasers was accomplished with a multicomponent mixture of Xe:N<sub>2</sub>:CO<sub>2</sub>:He with a ratio of CO<sub>2</sub>N<sub>2</sub>:Xe = 4:2:1. At the time of the experiment, the share of He in the mixture varied. Experimental investigations showed that in the discharge of CO<sub>2</sub> lasers with certain conditions, regular oscillations with characteristic frequencies of 30-80 kHz appear. The intensity and frequency of these oscillations depend on various parameters of the laser. The effect of oscillations in the discharge at the level of the output of the power of waveguide CO<sub>2</sub> lasers is considered. The effect of moving striations on the frequency fluctuations of waveguide CO<sub>2</sub> lasers is also investigated. Figures 3; references 6: 4 Russian, 2 Western.  
[150-6415]



## INVESTIGATION OF PIN-COMB RETARDING STRUCTURE FOR MILLIMETER BAND MASERS

Kiev IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: RADIOELEKTRONIKA in Russian  
Vol 24, No 12, Dec 81 (manuscript received 14 Jul 80) pp 9-14

CHERPAK, N. T., LAVRINOVICH, A. A., MYSHENKO, V. V. and SMIRNOVA, T. A.

[Abstract] The possibility is considered of using a pin-comb retarding structure [RS] in millimeter band masers. The dispersion characteristic and the delay with respect to the group velocity in the pin-comb with a dielectric are considered, and the experimental technique used is described. An investigation of the RS was made in the 6-mm band wavelength (35-55 GHz) at room and helium temperatures. In order to conduct the measurements, a RS made of copper was produced with dimensions  $D = 0.3$ ;  $d = 0.15$ ;  $b = 0.5$ ;  $h = 0.8$  and  $1.0$ ; length of RS  $l_c = 20$  mm. The results of the investigation showed that the RS of the pin-comb type can be successfully used in a maser in the middle wave part of the mm-band ( $\lambda = 8 : 4$  mm) with the use as an active substance of paramagnetic crystals with a moderate value of the dielectric constant  $\epsilon = 5-20$ . Figures 3; references 12: 10 Russian, 2 nonRussian (1 in translation).  
[153-6415]

## RECEPTION OF OPTICAL RADIATION MODULATED AT 10 GHz FREQUENCY BY HETERODYNING IN PHOTOMULTIPLIER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 9 Apr 80) pp 181-182

GULGAZARYAN, K. A., DIANOVA, V. A., MUSTEL', Ye. R. and PODOPRIGOROV, Yu. D.

[Abstract] A new receiver with heterodyning in the photomultiplier with a control grid has been developed for optical radiation modulated at frequencies of the order of 10 GHz. The semitransparent photocathode is located in the capacitive gap of the coaxial resonator, i.e., between the inner resonator electrode and the control grid. The light beam can be modulated by means of an electrooptical  $\text{LiNbO}_3$  crystal with synchronous interaction of light wave and modulating wave. The authors thank A. A. Solomko and V. S. Sidorenko for supplying the optical modulator used for this study. Figures 2; references: 5 Russian.  
[176-2415]

## DEFORMATION OF SURFACE OF ANNULAR REFLECTORS EFFECTED BY AXISYMMETRIC LOAD

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81  
(manuscript received 17 Dec 79) pp 10-13

LOKHOV, Yu. N. and ROZHNOV, G. V.

[Abstract] A complete investigation is made of deformations of an annular reflector under the action of an arbitrarily distributed transverse axisymmetric load  $q(r)$  with all possible methods for its strengthening at the interior and exterior edges. Generalized formulas are derived for calculation of the profile of the optical surface and the stresses developed in both a continuous and an annular re-reflector, which can be used in conducting similar investigations of the form of an optical surface and in the case of other methods of loading a reflector. Figures 2; tables 1; references:

5 Russian.

[156-6415]

UDC 534.284

WIDEBAND SURFACE-ACOUSTIC-WAVE FILTER

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 27, No 1, Jan 82  
(manuscript received 22 Oct 80) pp 184-186

BAGDASARYAN, A. S., BULYUK, A. N., KMITA, A. M. and FEDORETS, V. N.

[Abstract] An experimental wideband surface-acoustic-wave filter with variable spacing and capacitive suspension of electrodes has been developed and tested. Specimens of such a filter were produced on YZ-LiNbO<sub>3</sub> substrates by the photolithographic process, each device consisting of two identical transducers separated by a metal shield. The width of electrodes in the main array varies from digit to digit from 7.1 to 3.6 micrometer. The electrodes in the auxiliary array are spaced uniformly with a 3.6 micrometer period and excite surface acoustic waves within a narrow passband of the main array. The coverage of auxiliary electrodes corresponds to a rectangular envelope of the transducer pulse response. The filter has a linear phase-frequency characteristic and a low insertion loss. Its amplitude-frequency characteristic can be made sufficiently uniform in the passband by increasing the number of electrodes or changing the coverage of auxiliary electrodes and thus adjusting the amplitude of surface acoustic waves generated by each electrode pair. Figures 2; references 4: 1 Russian, 3 Western.  
[176-2415]

UDC 621.372.4:534.8

SURFACE-ACOUSTIC-WAVE RESONATOR WITH EDGE REFLECTORS

Moscow RADIOTEKHNIKA I ELEKTRONIKA in Russian Vol 26, No 10, Oct 81  
(manuscript received 27 Nov 79, after revision 30 Mar 81) pp 2213-2215

ROZHDESTVENSKIY, A. N.

[Abstract] This brief communication presents the results of an experimental investigation of surface-acoustic-wave [SAW] resonators which use the

reflection from the opposing edge faces of a piezo substrate. The characteristics of the SAW resonators were investigated at a frequency of 20.5 MHz. The  $8 \times 1 \times 15 \text{ mm}^3$  (x,y,z) substrate is made of lithium niobate of a YZ-cut with a nonapodized interdigital transducer (shown in figure 1) which contains 50 pairs of electrodes. Graphs are shown of the frequency characteristics of a SAW-resonator with edge reflectors, and a SAW resonator with a sectioned transducer (the interdigital transducer of the resonator contains 10 parallel-connected sections of a 15-section transducer). The results presented of an experimental investigation of the characteristics of SAW resonators with edge reflectors shows the possibility of their use as sensing elements of piezo pickups of temperature, with increased precision. Figures 3; references 2: 1 Russian, 1 Western.  
[138-6415]

## NEW ACTIVITIES, MISCELLANEOUS

UDC 061.4:621.3.004.18

### 'ECONOMIZING ON MATERIAL RESOURCES IN ELECTRICAL EQUIPMENT INDUSTRY' EXHIBITION

Moscow ELEKTROTEKHNIKA in Russian No 1, Jan 82 (manuscript received 23 Nov 81)  
pp 63-64

RYKOV, G. A. and TROITSKAYA, T. B.

[Abstract] A summary is provided of the content of the "Economizing on Material Resources in the Electrical Equipment Industry" permanent exhibition in the electrical equipment pavilion at the USSR Exhibition of Economic Achievements. In the electrical equipment industry the cost of materials equals an average of 65 to 70 percent of the cost of producing electrical equipment products and up to 85 percent of the cost of cable products. The exhibition has the purpose of displaying the methods which will help in the 11th Five-Year Plan period to make possible the entire growth in product output without the substantial involvement of key material resources, primarily of non-ferrous-metal rolled products. The industry combined system for economizing on materials is based on mastering and producing new types of products with reduced materials intensiveness, on introducing low-waste technologies and on improving methods of setting norms for, storing and keeping account of all material resources used in production. In the 10th Five-Year Plan period almost the entire growth in output was achieved on account of economizing on non-ferrous-metal rolled products. Not one item of new equipment is allowed to be produced if it is inferior to the best analogous piece of equipment in the world in terms of indicators for the specific consumption of key materials. Mass production feasibility indicators have been introduced whose decisive factors are materials intensiveness and the material utilization factor. Products below the world standard in this regard are not given the Seal of Quality. A unified series of 63- to 800-MW turbogenerators is being exhibited in whose production the consumption of copper has been reduced by 3.4 tons for each machine. The new high-power VL-84 electric locomotive represents a savings of 7500 tons of rolled metal on account of the reduction of specific weight per unit of power. A savings of 2.5 million rubles per year is represented by a fundamentally new technology for treating metals--the plasma mechanical technology. Measures have been taken for saving silver in the production of low-voltage equipment. Storage

batteries used for starters are being produced which represent a 0.8-kg saving of lead per single item. More than 10 million m of glass cloth were saved in the 10th Five Year Plan period by substituting scarce materials in the production of electrical insulation materials by less scarce ones and by creating new materials based on more accessible and cheaper raw materials. An automatic line has been introduced for the nesting of blanks of electrical sheet steel to be used in the magnetic circuits of electrical machines, with an 18-percent saving of this type of steel. Many parts fabricated by the cold forging and cold extrusion methods are represented at the exhibition. The use of powder metallurgy in creating electrical products represents a practically waste-free technology which eliminates machining and increases the metal utilization factor almost 2.5-fold. Composite materials with a reduced tungsten content and tungsten-free composite materials have been developed for high-voltage equipment. Exhibited also are magnets based on metal powders for use in high-torque motors with enhanced unit power. The use of the function-cost analysis method in creating new and modernizing already developed products and for designing low-waste technological processes has made it possible to gain a savings of 4000 tons of rolled non-ferrous metals and about 3000 tons of lead.

[167-8831]

UDC 629.785.023.26

#### INVESTIGATION OF EFFECT OF CONTAMINATION OF PROTECTING GLASS OF TELESCOPIC DEVICE ON ITS RESOLVING POWER

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81 (manuscript received 20 Aug 80) pp 36-39

DUBENSKOV, V. P., VASIL'YEV, V. Ya., POPOVA-DYUMINA, L. N. and MARINCHENKO, Yu. M.

[Abstract] The results are presented of a laboratory investigation conducted in order to evaluate the effect of contamination of the protecting glass of a telescopic device on its resolving power. The experimental data obtained make it possible to conclude: 1) The resolving power of a telescopic device, the protective glass of which is contaminated, deteriorates because of shielding, scattering and diffraction phenomena by contaminating elements, which leads to a decrease of the effective diameter of the input pupil of the device and redistribution of the light energy in the image; 2) The light diffusion by the contaminating particles of the protective glass which originates with their illumination by a source located beyond the limits of the field of view of the telescopic device does not exert an effect of the resolving power; 3) For a more complete estimate of the effect of contamination of protective glass on the resolving power of the telescopic device, it is necessary to evaluate their effect on the magnitude of the coefficient of the liquid diffusion of the device. Tables 4; references: 3 Russian.

[156-6415]



RADIATION DIVIDER FOR INFRARED REGION OF SPECTRUM

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 10, Oct 81  
(manuscript received 11 Mar 80) pp 43-45

VEREMEY, V. V., ROZHDESTVENSKIY, V. N. and KHAZANOV, A. B.

[Abstract] A cube consisting of two rectangular glass prisms is used in the creation of a beam splitter for the infrared region of the spectrum. The beam splitter is based on the fact that reflection from the interface between two identical media depends on the magnitude of the gap between them, changing from total interior reflection to almost zero during optical contacts. The concrete construction is described of such beam splitters with realization of materials having various refractive indices. Figures 2; tables 1; references: 4 Russian.  
[156-6415]

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